JOURNAL *of* FORESTRY

November
1928
Vol. XXVI Number 7

Published by the
SOCIETY of AMERICAN FORESTERS

Single Copy Sixty Five Cents Four Dollars per Year

JOURNAL OF FORESTRY

A professional journal published by the Society of American Foresters and devoted to all branches of forestry

Entered as second-class matter at the post-office at Baltimore, Md.

Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph 4, Section 412, P. L. and R. authorized November 10, 1927.

Office of Publication, The Lord Baltimore Press, 1500 Greenmount Avenue, Baltimore, Md.

The JOURNAL appears eight times a year monthly—with the exception of June, July, August, and September.

The pages of the JOURNAL are open to members and non-members of the Society.

Manuscripts intended for publication should be sent to Samuel T. Dana, School of Forestry and Conservation, University of Michigan, Ann Arbor, Michigan, or to any member of the Editorial Board.

Missing numbers will be replaced without charge, provided claim is made within thirty days after date of the following issue.

Subscriptions, advertising, and other business matters may be addressed to the JOURNAL OF FORESTRY, Room 517, Lenox Bldg., 1523 L St. N. W., Washington, D. C.

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VOL. XXVI NOVEMBER, 1928 No. 7

The Society is not responsible, as a body, for the facts and opinions advanced in the papers published by it.

EDITORIAL

CONVERTING AUTHORIZATIONS INTO APPROPRIATIONS

THE passage last spring of the McNary-Woodruff Act and of the McSweeney-McNary Act marked 1928 as a red letter year in the history of forestry in this country. This action was widely heralded as completing the basic legislation necessary for the establishment of a definite and comprehensive forest policy for the nation.

The Acts of March 3, 1891, of June 4, 1897, and of February 1, 1905, had provided for the creation and administration of the National Forests; the Weeks Law of March 1, 1911, had provided for the enlargement of the National Forest system by purchase, and for cooperation with the States in fire control; and the Clarke-McNary Act of June 7, 1924, had provided for greatly increased cooperation in many directions with both states and private owners. Then came the McNary-Woodruff Act authorizing the appropriation in three years of $8,000,000 for National Forest purchases, and the McSweeney-McNary Act authorizing a program of research in all phases of forestry which by the end of ten years would involve an annual expenditure of approximately $3,500,000. Administration, cooperation and extension, and research had now been provided for; apparently the picture was complete.

Such an achievement is just cause for satisfaction. It should not, however, blind the friends of forestry to the fact that constant vigilance is necessary to insure the execution of the program which they have been supporting. Authorizations are not appropriations. So far as their practical value is concerned, the two laws of last spring are virtually dead letters until the money necessary to put them into effect is made available. Furthermore the McNary-Woodruff Act authorized an expenditure of only $8,000,000 in three years, instead of $40,000,000 in ten years, as had been advocated by proponents of the bill. The larger amount is still necessary for the adequate expansion of the National Forest system.

The recommendations of the Administration concerning the budget for forest acquisition and forest research will not be known until after Congress meets. If they are in accord with the program contemplated by last spring's legislation they should receive the hearty endorsement of every one who believes in these activities. If not, members of Congress should be informed of this fact with the urgent request that the budget be modified to conform with the approved program. It is fair to assume that Congress is normally disposed to put into effect legislation which it has passed; but in the face

of adverse recommendations from the Bureau of the Budget it is far more likely to do so if it has unmistakable assurance that such action is in accordance with the wishes of the people generally. It should be left in no doubt on this point so far as forestry is concerned, either this year or in the years to come.

One other phase of the situation deserves consideration. Appropriation of the amounts authorized by the McNary-Woodruff and the McSweeney-McNary Acts will place a heavy responsibility on several bureaus in the Department of Agriculture, and particularly on the Forest Service. This is especially true of forest research. Sudden expansion of the work in this field will involve many difficult problems in organization and in the training of inexperienced investigators. Ample funds in themselves give no assurance of high grade research, and the Forest Service and other bureaus will be put on their mettle to produce results of outstanding merit. Increased resources will strengthen the demand for increased quality of output.

Foresters will do well not to view the present situation with too great complacency. The foundation has been laid for substantial progress, but this will materialize only as the legislation now on the books is actually put into effect and as such supplementary legislation as may prove necessary is enacted. The immediately urgent task is to see that existing authorizations are converted into adequate appropriations, and that the funds thus made available are used to best advantage. Such things do not take care of themselves. Is it not up to the foresters to take the leadership in seeing that they are done?

TROPICAL FORESTS AND TOMORROW

By TOM GILL

Forester, The Charles Lathrop Pack Forestry Trust

MISCONCEPTIONS regarding the forests of Latin America are many and profound. Tales that come back from those forested countries south of us often prove incomplete and conflicting. American foresters themselves have failed to reach any common meeting ground regarding the importance of these forests, or the rôle they are destined to play in solving our own domestic forest problems. Briefly and bluntly, we do not know even within the limits of intelligent guessing how much timber these tropical countries contain, what the composition of their forests is, or how accessible they are.

The term tropical forestry is itself an all-inclusive name for something that really consists of a number of widely varied and often unrelated practices. There is some danger that the very convenience of the term lends a false color of simplicity to something that in reality is extremely complex. For its forms are just as diverse and varied as the forms of forestry that are carried on within the temperate zone—activities that we might bulk under the simple, but not very helpful, term of "temperate zone forestry."

After all, forest practice must be as varied as the conditions in which it functions, and the tropics themselves—or more specifically the Latin-American tropics—present every conceivable gradation of climate, from hot, torrid seacoast, to lands too cold and high for tree growth; from arid desert to the wet, impenetrable jungles of the rain forests. It is in the tropics that within less than a score of miles one may pass from dry, cactus-covered desert, to wet, alligator-infested jungle swamp. No wonder, then, that the term "tropical forestry" has failed to evoke, for most of us, anything more than a hazy composite picture of rank, vine-twined forests, or long rafts of mahogany and cedar floating on some tropical lagoon.

Another difficulty that lies in the way of investing the tropical forestry problem with reality has been the failure on the part of foresters in the temperate zone to realize that a very real problem does exist there. With most of us the conviction persists that nature so lavishly endows the tropics with moisture, soil fertility, and everlasting sunshine that tree growth presents no problem—that the forests themselves are fool-proof. As a matter of sober fact, this is very far from the truth. Satisfactory regeneration of tropical forests after lumbering presents problems that tropical foresters have solved to only a very limited extent.

In the first place we know almost nothing about the behavior of the many species with which the tropical forester has to deal, although three centuries of unrestricted cutting have taught us what happens to tropical forests that are cut over and left to the healing care of nature. We do know that with few exceptions the removal of valuable species is followed by a rapid growth of more or less worthless tree weeds which seize

the soil and spring up to form an impenetrable jungle—a hopeless mass of riotous vegetative life, not only worthless in itself, but an absolute obstacle to the reseeding of more valuable trees for many decades. Cuba, Haiti, Porto Rico, Trinidad, practically all of the West Indies, are striking examples of what happens to mishandled tropical forests. There is hardly a stick of accessible commercial timber in Haiti today. Porto Rico is suffering from a very real and severe timber famine, and Trinidad is obtaining nine-tenths of its wood from Canada and the United States.

True, in the tropics nature usually succeeds in covering over man-made scars quickly and completely, but to nature a forest of worthless *almacigo* or *acacia* brush is just as satisfactory a ground cover as mahogany or rosewood. Even in pure stands and where advance reproduction covers the ground, there is no certain guarantee that logging will be followed by a growth of the same species. In Trinidad is a fairly large forest of that valuable timber tree known as mora (*Dimorphandra mora*). Beneath the shade of these parent trees the ground is covered so thickly with young mora that one would have thought it necessary only to remove the over cover and the new forest would take care of itself. But actual cutting showed the error of this assumption. Within six months after cutting, the advance growth of mora reproduction was choked by the swift growing trees that invaded and preempted the ground. And all this simply means that the technique of securing natural regeneration of desirable species has not yet been worked out, has in fact scarcely been begun.

American foresters in Haiti and Porto Rico find themselves with the problem of reforesting land that centuries of pillage and nomadic agriculture have laid waste. With no foundation of research or past experience to build on, they have begun to study the adaptability of various species for the many types of soil and site. But they can not wait for the results of that research. They are faced with the immediate necessity of taking their courage in their hands and reforesting the eroding slopes of these islands with species that give promise of best results. Even the British, who as a whole have attacked their forest problems more thoroughly and exhaustively than either the North or South Americans, know very little about the behavior of even their most important tree species. Spanish cedar, next to mahogany the most valuable tropical forest species, still remains an enigma so far as its successful regeneration is concerned. Spanish cedar has been planted over many hundreds of acres and studied for almost a decade, but to this day foresters are unable to predict with any degree of certainty the success or failure of cedar plantations under any given set of conditions.

So from the standpoint of reforestation there is immense and immediate need for adequate research into nursery practice, plantation technique, and silvicultural requirements of tropical species.

And we are but little better off botanically. Record's "Timbers of Tropical America" is the one significant attempt, in this country, to bring scientific order out of the chaos of common names that have attached themselves to tropical tree species. It is an immense help to

tropical foresters. But even here much remains to be done. The exact determination of many a commercial tropical timber species is still undecided. Mora, the most important commercial species in Trinidad, probably consists of two distinct species, one durable, the other not, but both lumped indiscriminately together for the market. Of the mahoganies, that most important of all tropical timber genera, two of the five known species were undescribed as late as 1920, and only a few months ago a new species has been identified in the Amazon Valley. From Santo Domingo a species of timber tree is being sent into the United States whose family is not known. In countries as close to the United States and as well covered by botanists as Haiti, undescribed tree species are being discovered every year.

From the so-called "practical" point of view—the point of view of exploitation and lumbering—more modern logging methods would be a boon to tropical forests and tropical forestry. Today in the countries about the equator, logging is a thoroughly primitive, unsatisfactory, and haphazard process. Methods are slow and wasteful, and because of the highly selective character of logging, the costs vary from merely high to prohibitive. Not only is logging expensive but so loosely organized is native labor that the output of forest products undergoes enormous variations in quantity, from month to month. There is no steady flow of ties or logs or any other product. For that reason industry has been very loath to consider seriously so uncertain a source of supply.

But more important still, industry has always been unwilling to play the pioneer in testing the possibilities of unknown species which may or may not prove satisfactory, and which even if satisfactory may or may not exist in commercial quantities. For these reasons the introduction of tropical woods on the markets of the United States, and to some extent in Europe, has been a slow and difficult procedure. True, more tropical species are being used in the States today than we have any general knowledge of. A great many of the woods used as cores for veneered furniture are of tropical origin. Thousands of railway ties in the Netherlands come from Surinam, South American greenheart has been shipped for wharf construction to many parts of the earth. But the great bulk of tropical species are still unknown to commerce. And this, in spite of the fact that many certainly possess the same characteristics that make some temperate species highly prized.

But we are learning slowly, here in America, that the unsuitability of tropical woods for general use is an unfounded prejudice. We have come to learn in the face of necessity that nearly every timber species possesses some value, and only awaits our knowledge of what that value is. Often the problem boils down to the proper technique of seasoning. Red gum, not so many years ago, was regarded as a thoroughly unsatisfactory wood, because of its tendency to tie knots in itself while drying. Proper seasoning methods today have removed that objection and have placed this species among our important commercial species. So it is with many tropical woods. We know too little of the technique of seasoning or the purpose for which these woods are best fitted. Just as we have learned that white pine is

not suitable for axe handles, or cottonwood for pilings, we must learn for the more abundant tropical species their value and their limitations.

Some tropical woods already suffer undeservedly from a bad reputation in North America. Greenheart, for example. The history of greenheart's fall from grace is a lesson in improper utilization. American engineers sought for the construction of the Panama Canal a strong wood immune to attacks of the teredo. Out of one hundred and fifty species tested, greenheart proved to be the most satisfactory. Large quantities were used in the locks of the Canal. But to the consternation of the builders, no sooner had it been put in place than it was attacked by marine borers and quickly destroyed. Immediately word went out that greenheart is worthless as a teredo-resisting wood. The truth is that greenheart, though not affected by the teredo which exists in salty water, falls an early prey to another pest, the neo-teredo, infesting the brackish waters of the Canal Zone.

So all in all we can't feel that there yet exists any body of knowledge on which we may safely base action or prophesy concerning our tropical forests. But an important beginning toward securing that knowledge has already been made.

Early in 1927 the Charles Lathrop Pack Forestry Trust became interested in tropical forests as a probable factor in our problem of wood supply. It agreed to lend its forester to the Tropical Plant Research Foundation for six months yearly during a period of three years, to explore the forests of the tropics. This Foundation, which has carried on various research projects in the tropics, was fortunate in having associated with it men whose names stand high in the field of tropical forestry. Major George P. Ahern, a trustee of the foundation, who had formerly been Director of Forestry in the Philippine Islands and organized the administrative and educational work there; D. M. Matthews, one time Conservator of Forests in British North Borneo; H. N. Whitford, formerly Professor of Tropical Forestry at the Yale School of Forestry; and William Crosby, all have at one time or another carried on forestry studies for the Foundation. These men had built up a background of tropical forest experience and research that among other things has served to emphasize the great need for specific facts—facts that could only come from a field survey of the forests themselves. It was to carry out this survey that the three-year program of exploration has been planned.

Its purpose is two-fold. First, a study of the extent of the forest resources of the American tropics to determine the areas and amounts of important timber types, essentially a stock-taking inventory of tropical forests. Second, a more specific investigation into the commercial possibilities of the species whose abundance may lend them commercial interest. For this work logs of representative trees are being sent back to the states for laboratory and actual factory tests. The botanical identification will be made by Prof. Samuel J. Record, of the Yale School of Forestry; the laboratory tests are under the supervision of the School of Forestry and Conservation of the University of Michigan.

The difficulties are many, the possibilities far-reaching. Yet the trustees of the Foundation harbor no illusion

that three years will serve to unravel the enigma of the unknown tropical forests. The frontiers of those forests are too far-flung for complete investigation within so short a time and a personnel so limited in number. But a working beginning can be made, and a good insight got into the character and extent of the more accessible, the potentially commercial stands. For the great unknown hinterlands, the unmapped interiors, human knowledge extends only to the vague tales of wandering Indian tribes. Any complete study of these must remain for later investigators.

The first year of exploration has passed. It covered the islands of the Caribbean, the eastern half of Venezuela, including the great Orinoco Basin, and that heavily timbered colony, British Guiana. The coming winter will be given over to a study of the western part of Venezuela, the forested shores of Lake Maracaibo, and the wooded portions of Colombia, Central America, and southern Mexico. The entire last year will be devoted to a study of that greatest of all tropical timber storehouses—the Valley of the Amazon.

Already the first year's study has drawn a fairly complete picture of forestry practice and forest conditions in the islands of the Caribbean. It has raised the curtain a little on the forest wealth of the lower Orinoco. From Venezuela and British Guiana test logs will provide laboratory research into the utility of certain abundant species. Already the body of facts on local wood use is increasing and should prove suggestive to investigators in this country.

But once we possess a body of definite knowledge covering the amounts and physical characteristics of certain accessible tropical species—what then? What is going to be the effect on our own hardwood industry? Many lumbermen and some foresters look with foreboding toward this possibility. They see ship load after ship load of tropical timbers flooding the United States and ruinously swamping a market already glutted by frantic over-production. But to most of us familiar with conditions in the tropics, the possibility of any such sudden and disastrous invasion seems negligible. Increasing use of tropical species in the United States will come about as a more or less gradual infiltration and will come as an answer to an actual need. It will be a need arising from the economic exhaustion of certain of our own species, or through the unchallenged superiority of certain tropical species for certain specific purposes.

The work of the Foundation and the results of the survey far from being a menace to the hardwood industry should serve to direct and point the way to a more rational and purposeful form of exploitation.

The facts that the survey seeks are not being obtained a day too soon. The need is already upon us. Already certain lumber companies seeing before them the end of their own domestic wood supply are scouting and purchasing in Central American and Mexican timberlands. The American lumber industry is not saying much about this. Naturally. It would not be compatible with a program for stressing the inexhaustibility of our own forest resources to announce the purchase of timberlands in foreign countries. But it is a very natural evolution, and it is going on.

The present survey hopes to answer the two great questions that industry is bound to ask, the two questions that must be answered before time or money can be spent intelligently in the forests of the tropics. Industry is asking, first, "What are these tropical species good for?"; second, "How much can we get?"

Exploration and research. Therein lies the answer. In that way alone can these great storehouses be unlocked and their contents made available not only for America, but for many a wood-hungry country of the old world.

THE HARDWOOD PROBLEM OF THE NORTHEAST

By AUSTIN CARY
Logging Engineer, U. S. Forest Service

THE scheme of girdling and so killing hardwoods in the interest of better types of growth on the timber lands of northern New England has been taken up just lately by the local Section of the Society; it is an idea also long familiar to New England woodsmen. Its rationale is not occult or far to seek. On great stretches of land far removed from population are stands of mixed character, the softwoods valuable and readily available through water transportation, the hardwoods not adapted to driving and no other means available without excessive cost. Comparatively speaking too, these hardwood stands are of rather low character, the volume light and defect and poor form prevalent. Lastly, the hardwood element in these mixed stands works to the disadvantage of the more valuable trees silviculturally, taking up room, suppressing small trees, and creating ground conditions unfavorable to reproduction of softwoods. The natural balance on large areas was long ago voted to be one not most favorable to the interests of mankind, and with commercial cutting of our forests the balance has become more unfavorable.

Most of this any observant person could see as earlier indicated, and just as easy was the suggestion that it might be well to do something about it designedly. Hardwood cutting for firewood, dams, camp buildings, etc., often illustrated what might result in the way of increased growth on existing softwoods; girdling was familiar from its employment in land clearing; hundreds of men probably have speculated on the effect and wide applicability of this measure. Foresters too have had it in mind for some years. Thus the idea was early and strongly impressed on my own mind, and 30 years ago in an address to the Pulp and Paper Association I advocated girdling as a practical measure. Nothing substantial came of that, however; a little testing of methods and some work not much more ambitious carried out a few years later at Corbin Park is all that so far as is generally known was ever done. Therefore, as far as concerns execution, and even adequate and accurate test, of the method, the foresters of today have the field to themselves.

A start has, however, been made already. Some two years ago the Finch-Pruyn Co. of New York, guided by their forester, Mr. Churchill, who has told of it in this journal, took their courage in their hands and are now carrying out this measure on a large scale on certain types of land in their Adirondack property. Somewhat earlier, too, I took the matter up again in New England with the idea that it ought to be brought to the fore and pressed to a conclusion. Here was an idea applicable to millions of acres. The cost certainly would be light, vastly less than that of plantations, easily within the means of owners and industries today. Chance illustrations of the results to be expected looked most promising. The greatest obstacle in the way, provided of course the measure on full consideration look sound, seemed to

be mere inertia, and the forestry profession of the time, it seemed, ought to be able to overcome that.

Reference to two matters from the somewhat distant past will serve to emphasize some pertinent considerations. Along about 1900, Dr. Fernow, dean of the profession at the time, was operating Adirondack lands according to his conception of the principles of forestry. Lands predominantly in hardwood were what he had to work on. The native stand he cut, as cleanly as possible, for no net yield or at a loss even, with a view to planting spruce on the territory. Only one of the various sequences concerns us here, the fact that 20 years later Adirondack hardwoods had good value, were being operated in their own right. In fact an Adirondack concern handling the two kinds of timber to equal advantage told me in 1920 that spruce brought them less net revenue per thousand than did hardwoods.

That on one side, this on the other: At the same time I was myself working for a company on the Androscoggin in Maine. In its holdings were large areas of mixed growth once cut through, with abundance of pulp size spruce on them that was in large measure impeded in its growth by hardwoods of no value. I advocated girdling these hardwoods but could not get sanction for the measure. Those lands stand in the same or worse growing condition today; no prospect of marketability of the hardwoods concerned is now evident to the outsider; 30 years of much enhanced growth of spruce and fir, amounting to several cords per acre it would appear, should certainly have added vastly to the returns from or the present value of that territory. Now as then therefore it looks to me as if I proposed a promising measure.

The cases differ in respect to two main factors,—stand and intrinsic quality of the timber itself, and the development of transportation. Much Adirondack land is strong in hardwoods, with stands of merchantable timber up to six thousand or more per acre, a strong force of reproduction going with that. In New England on the other hand only on very limited areas does land yield as much as three thousand merchantable lumber; one and two thousand are far more common; on the greater part of our territory the great bulk of the timber is of small size or defective in form or quality. On the transportation side also there is a contrast. Around five million acres in a body in northern Maine are not tapped by railroad, and much of the spruce-hardwood region of the northern New England States does not lend itself readily to such transportation. The problem then is not silvicultural solely, or even mainly. Precedent as just shown points both ways, cannot be looked to as leading. There is need for careful thinking, therefore, for decision in the individual cases and in these circumstances final determination of policy, of course, rests with the owner whose direct interests are concerned.

Others may, however, formulate the conclusion that appears most reasonable to them, and this in the case of the writer broadly favors the measure. Granted, as must be done, the relatively light stand and low value of our hardwood in the commercial sense and the difficulty arising in its transportation, the likelihood of its profitable utilization on great areas seems remote. In this the possibility of producing lumber of small as well as

large dimensions has been taken into account, also relations to the paper-making industry. True, hardwoods are being used in a number of New England paper mills of late years, but the quantity is trifling compared to the volume of the resource; vastly greater amounts could be gathered in on short hauls and permanently; this condition arises, too, just when competition in paper manufacture is springing up in several and widely detached sections of the country. Girdling hardwoods on distant and difficult lands in the interest of increased growth and more abundant reproduction of the softwood species looks promising therefore, a measure fit for wide if discriminating application.

Just what may the killing of hardwoods on these northern lands be expected to do? What will the cost be, and about what the returns? What are the best methods? What are essential safeguarding considerations? Mr. Churchill has written of these things somewhat already. The Section as first stated is taking them up. It has been suggested that the present writer put on record his own views and experience.

In the first place indiscriminate killing of hardwoods is *not* advocated; no one brought up in the thrifty, cautious atmosphere of New England would advocate any such measure. Only where definite and commensurate good seems in a way to be accomplished is the expenditure of money in this direction suggested. That limits the measure to areas on which softwood in some form and of some promise exists already. This may be in the form of pulp timber, trees that are six inches and larger in breast high diameter; discriminating killing of hardwood would clearly add to accretion on them. Second, we have in most mixed woods numbers of spruce and fir trees from 2 to 5 inches in diameter, with wonderful power of recovery from suppression in them; new life may be given to such trees by freeing, many of them rescued from extinction and nearly all put in the way of rapid growth. Third, there is the reproduction, abundant often and with great possibilities for the more distant future, of distinct significance to an industry of as permanent type as our paper-making industry has always been thought to be. This, however, has to be treated with the idea in mind of possible suppression by the deciduous trees and shrubs native to much territory. Lastly, we have *permanent* composition of the woods to think of. Temporary composition it is clear can be largely influenced, but there seems to be promise of the other as well. Moss and annuals for soil cover according to present knowledge favor the reproduction of spruce and fir, while hardwood leaves are known to impede it. To diminish the supply of these leaves may therefore change the soil cover, stimulate reproduction of the species we want, reverse the strong tendency to hardwood which former handling of our mixed growth lands has created and which men believe they see in effect on extensive territory. This is an idea undemonstrated yet, so far as I know. It seems worthy of the most accurate observation, as by experiment station workers.

Of methods Mr. Churchill has written; on the basis of effectiveness and cost he favors a chop into the tree, one only, made in winter. With more experience behind him than any other man, his verdict should stand; still other methods may be desirable in certain cir-

cumstances. My own work has perforce been done in summer, and two methods were tried, peeling off a strip of bark and notching. Of these the second appears best, as before on the basis of both cost and effect. Thrifty birch and maple treated three years ago have in some numbers covered the peeled surface largely over with thin new bark that promises to prolong the life of the trees considerably if not indefinitely. On the other hand a notch into a tree, if carried through seams and reentrant angles, winds it up permanently. This we have found may most readily be made, not with an upward and downward stroke of the ax, but with two strokes downward, the second above the first. This way the vital outer surface of the woods seems to be broken with least labor.

What next of safeguards? Of these, that against wind is of first importance, for blowdown of pulpwood timber of any amount, whatever other benefits might be likely to arise, would surely condemn this measure with timber land owners. In the work I have carried on I have felt under obligation to back entirely out of some territories with tall pulpwood timber scattered among hardwoods. Danger of suppression coming to softwood reproduction on lands at all strong in deciduous growth of any kind is another consideration entitled to careful thought. The rule adopted for general use in the work that has been done was not to count on softwood advance growth unless it was at least 5 feet high.

Cost of the work will be best covered by means of specific examples. Thus September 3, 1925, on a measured acre of cutover land strong in hardwoods but with abundant reproduction beneath, the hardwoods were mostly girdled. The cover at the start was estimated at .7; 136 trees running all the way from 3 to 22 inches in breast high diameter were killed, with a basal area of 71 square feet. Three or four trees of large size and fine quality, also a number of big trees that seemed in the way of early natural death, were left ungirdled. Two axes did the work in two hours' time. Following the notching methods indicated above, two minutes net were required to girdle a tree 18 or 20 inches through, one minute for a tree of 8 or 9 inches.

The next season, 1926, some 30 acres in the Moosehead region were treated in the same fashion. Account will be given of one body of 19½ acres that was treated with 52 hours of ax work net. The hardwood cover here was estimated at .4, more typical of these northern lands than the preceding; 62 hardwoods per acre were killed, the basal area around 30 or 35 square feet. To get an idea of the result likely to follow, as each hardwood tree was girdled fir and spruce over 5 feet high that would clearly be helped by its extinction were tallied, by diameter classes. The upshot is that two trees were helped for each one killed, per acre 49 trees 3 inches and over in breast high diameter and 71 of smaller size. (See Table 1.) This softwood stand, it will be seen, is a generous one, well worth the expenditure of effort, though that will vary in different territories. The cost per acre at current wages for axmen and with what looked like fair allowance for supervision and overhead came to somewhat less than $1.50.

Certainly before this work is carried out on a large scale some lines should be laid down as to relative cost and expected result, the amount of hardwood to be treated, and the number of trees favored.

Carrying out that idea will involve training of men, cruising ahead, etc., involving considerable overhead expense. The question of maintenance comes in too, and circumstances favoring cheapness and effectiveness of the work in a general way. It seemed to us on the job that such work might well be done right along with a logging operation, in which case and in course of time putting land in order for growth would come to be looked on as a constituent part of operating work.

Some definite indications of the response of land to this treatment have been gathered. In August last, two and three years after the operations above referred to were carried out, the areas treated were visited and note made of the results to date. The present condition of the hardwoods will be taken up first.

About half the trees girdled, in both years, put out leaves in 1928, and on many trees these seemed to have normal development. Yellow birch was more generally dead than either beech or maple; the judgment was formed that there would be little foliage on the girdled areas next year; it is known that but few trees failed to leaf out the first year after girdling. On the area treated in 1925 half a dozen hardwoods of different size and kinds had fallen down, while big pieces of the tops had fallen out of a few maples. None of this was in evidence on the land treated the next year. In general, conditions looked favorable to the purpose of the work. The trees when they come down will mostly come piecemeal; this will be an extended, continuing process; destruction of young growth and fire risk will both be minimized for this reason.

The response of the softwoods was marked and general, and it was proved to be the result of the girdling by examination of contiguous areas. Borings showed a response in diameter growth on the part of sizeable trees; 1928 leaders 8 inches and longer on both fir and spruce were quite general where the cover had been opened, against a fraction of that under hardwoods. This gain in height growth showed in trees of all descriptions. Thus a fir now 4 feet high under two big beeches that died early showed the following height growth in the different years—1925 (the year of girdling), $2\frac{1}{2}$ inches; 1926, $3\frac{1}{4}$ inches; 1927, $10\frac{1}{2}$ inches; 1928, 16 inches. On the same area an umbrella fir (long suppressed, with spreading limbs and little or no height growth) got itself together in the course of two years and in 1928 produced a leader around a foot long, one more evidence of the power of re-

TABLE I

NUMBER OF SPRUCE AND FIR TREES ON 19½ ACRES OF MIXED LAND IN THE MOOSEHEAD REGION HELPED BY GIRDLING HARDWOODS

	Diameter							
Species	Under 3″	3″	4″	5″	6″	7″	Over 7″	Total
	Number of Trees							
Spruce	394	65	51	41	43	21	38	653
Fir	998	343	164	96	56	25	14	1696
Total	1392	408	215	137	99	46	52	2349

covery of our pulpwood species as well as of the effect of exposure to sunlight upon them. Perhaps the most striking instance of the effect of such exposure, however, was noted two years ago, in 1926. As two of us came off the work done in the Moosehead country we traversed a road, highway really, cut out and built in 1914. Alongside this road were numerous young softwoods that during the intervening time had grown under full sunlight, and a fir of this description was cut, $3\frac{1}{2}$ inches in breast high diameter and $20\frac{1}{2}$ feet high at the time. It had 25 rings at the stump, some 3 inches from the ground; it had grown 17 feet in the last 11 years, 12 in the last 6. Next, stepping off from this road, we cut 2 representative fir trees under the usual cover of hardwoods. One $9\frac{1}{2}$ feet high with 30 rings at a 3 foot stump had grown 32 inches in the last 11 years. The second was 18 feet high, and had 88 rings 2 feet from the ground; in the last 11 years it had grown 69 inches.

Figures suggested by these observations applied to numbers of trees per acre suggested by the record that has preceded indicate what we might expect from application of girdling to our northern mixed areas wholesale. Height growth of something like a foot a year as against a quarter or third as much seems to tell the story approximately and in brief. That would shrink vastly the time required for the production of another crop of pulpwood and multiply by several times the volume of production of useful wood on the lands in question. That is of consequence not only to industry in general and the public, but to the land owner, to whom the following presentation of the case should make strongest appeal—that the way suggested looks to some of us like the cheapest way by which so much pulpwood can be acquired. Definite and well based figures for comparative growth whenever they are available will help, as owners debate this matter. On the side of cost this estimate by the writer may serve a purpose until something more reliable is had—that the added growth of two to four years ought to pay for the work.

Before concluding, it should be said that this paper is not my own entirely. Certain of the New England foresters in commercial employ are studying and working along these lines. They have helped in the field and in thinking, though they are not committed by what has been set down.

RAILWAY FIRE PROTECTION IN CANADA[1]

By CLYDE LEAVITT

Chief Fire Inspector, Board of Railway Commissioners for Canada

EVER since the steam railway became an important factor in the progress of civilization, it has been recognized as a serious fire hazard to adjacent forest and other property interests.

The existence of this hazard was specifically recognized in the original Railway Act of 1903, in which provision was made for the establishment of the Board of Railway Commissioners for Canada. In that Act, the Board was empowered to make regulations respecting the use of fire-protective appliances on locomotives and for the construction and maintenance of fire guards, the latter being limited in practice to the western prairies. A clause in the Act required railway rights of way to be maintained free of unnecessary combustible matter.

In 1907, the Board issued its first order on this subject, prescribing standards for fire-protective appliances on locomotives, prohibiting the use of lignite coal as locomotive fuel, and requiring the construction of fire guards along railway lines in Alberta and Saskatchewan.

Experience showed, however, that these requirements were not sufficiently comprehensive to protect the public interest from forest losses due to railway fires. In a bulletin published by the Dominion Forestry Branch in 1911, R. H. Campbell said: "The record of each year's conflagrations shows the railways well up in the list of the causes of forest fires. If they do not lead, they always follow close in the black array." McMillan and Gutches, in Bulletin No. 9 in 1910, stated: "Railways are a prolific source of danger to forest land, from the time of the first location survey. The most destructive fires usually originate from the construction camps, but fires start every year as long as the road remains in operation and timber remains along the line." The British Columbia Royal Commission on Timber and Forestry in 1910 reported: "It is a truism that railways are the most frequent cause of fire in any timber areas through which they pass."

So serious was the situation that the British Columbia Government in 1909 made application to the Board for the issuance of regulations which should provide additional and adequate protection from railway fires for the great forests of that province. In this application, the Dominion Forest Service and the Commission of Conservation of Canada later joined. Largely as a result of this agitation, the Railway Act was amended in 1911 to give the Board wider powers in prescribing measures to be taken by the railways for the prevention and control of fires.

Hearings were held by the Board at various points and in May, 1912, an order was issued revising and improving previous requirements and adding many new features. Provision was made for the organization of the Fire Inspection Department of the Board, under the immediate direction of the newly appointed

[1] Prepared for British Empire Forestry Conference, 1928.

Chief Fire Inspector, whose duty it became to supervise field inspection and generally to see to the enforcement and administration of the Board's new fire regulations.

These regulations have been amended from time to time, so that it will be of greater interest to describe the present situation than to follow the history of the minor changes. The latest revision is embodied in General Order No. 362, dated April 19, 1922.

First, it should be understood that the order applies to all lines under the Board's jurisdiction, comprising nearly 40,000 miles or 97 per cent of the total railway mileage of Canada. It does not apply to the several minor railways which are owned and operated by Provincial Governments, or which, though privately owned, derive their charters from a Provincial Government, as distinguished from those which hold charters granted by the Dominion Government. Fire protection on the small mileage not subject to the Board is a matter for the Provincial Governments concerned.

Following is a brief description of the essential points of the Board's order:

1. The order applies to railways under construction, as well as to those in operation. This is important, since the construction stage was in the earlier years the most destructive of forests. Contractors had no direct interest in preventing fires, laborers were careless, and fire had to be used freely in disposing of débris from right-of-way clearing. All this is now radically changed.

2. Standards are set for fire-protective appliances in front-ends and ashpans of locomotives, calculated to reduce as much as possible the emission of dangerous sparks. Railways are required to make weekly inspections of all such appliances, and are forbidden to operate locomotives in a defective condition. Check inspections are made constantly by officers of the Board. Experience shows that such an independent check by Government inspectors is absolutely necessary to ensure prompt detection and repair of fire-protective appliances. Here it may be observed that no practical device is in use on this continent, so far as known, which will entirely overcome the emission of sparks from stacks of coal burning locomotives, without at the same time seriously interfering with the steaming capacity of the engine. With proper care, however, the danger can certainly be very greatly reduced, and probably eliminated except during periods of high temperature and low humidity, when even the smallest spark may set a fire. Canadian railways maintain a very high standard in their locomotive fire-preventive devices.

3. Unless extinguished immediately, the deposit of fire, live coals, and hot ashes on tracks or right of way is forbidden, except in pits provided for the purpose. Many fires have been set in earlier years by firemen dumping ashpans while the locomotive was running. This is now largely impossible, although not yet completely so.

4. Special spark-arresting devices, to be approved by the Board, are required where it is desired, during the fire season, to use coals not possessing good coking properties, the use of which with standard front-end fire-protective appliances results in the emission of sparks from the stack to an extent deemed by the Board to be dangerous to the public interest.

Lignites and certain sub-bituminous coals fall within this category.

5. The danger of fires being set by smokers throwing live cigar and cigarette butts and similar materials from trains is minimized by the compulsory posting of warning notices in cars and compartments of cars in which smoking is permitted, and by verbal warnings given by trainmen. Smoking is usually permitted in second-class coaches and in hot weather the windows are generally open. The rear platform of the observation car is another possible source of trouble from burning smoking materials. A clean right of way is of course an excellent preventive of such fires, since a cigar or cigarette butt or lighted match can not be thrown any great distance from a moving train. To a limited extent, car windows are screened, but this is not compulsory, due to the cost, the interference with vision of passengers, and the added difficulty of keeping windows clean. Further, adequate positive proof is lacking as to the seriousness of fires caused by smokers on trains, since the evidence destroys itself, and since such fires can rarely be distinguished from those caused by sparks from ashpan or stack of the locomotive.

6. Railways are required to construct and maintain fire guards in the prairie sections of the Prairie Provinces (Alberta, Saskatchewan, and Manitoba), in accordance with the direction of the Board's Chief Fire Inspector. These fire guards can be seen by anyone traveling through the prairies, and have proved very effective in stopping the occurrence and spread of grass and stubble fires. The guards consist of plowed strips four or eight feet in width, according to the character of the hazard. Plowing is at from 200 to 400 feet from the track, usually on private land, permission for which use of private or public property is granted by law. In the case of so-called wild prairie land, dry vegetation must be burned off between the fire guard and the track. In grain stubble and cultivated hay lands, the bulk of the plowing of fire guards is done by farmers in return for old ties from the track, which they use for fuel. Only to a very limited extent are plowed fire guards constructed in forested territory, due largely to the very heavy cost for clearing and maintenance.

7. The Railway Act requires that railway companies shall maintain their rights of way free from dry grass, weeds, old ties, and other unnecessary combustible matter. Disposal of such débris is generally feasible only by the use of fire. Carelessness by section forces in the burning of débris has been a prolific source of fire trouble in former times and has not yet been entirely overcome, although very great progress has been made. The Board's order provides that no such burning shall be done except under such supervision as shall prevent the spread of fire beyond the strip being cleared. The Chief Fire Inspector or other authorized officer of the Board may require that no such burning be done except on written permit. Thus, the primary responsibility for adequate supervision and control of protective burning is placed on the railway, but officers of the Board's Fire Inspection Department may (and very frequently do) intervene by assuming direct control, under the permit system, of regulating the setting out of such fires.

8. Railways are required to provide and maintain a staff of fire rangers or patrolmen during the fire season, the details of personnel and equipment of which are to be in accordance with the direction of the Board's Chief Fire Inspector. This requirement broke new ground in Canada. In the beginning, these railway patrols were mostly by special men on track motor cars (power speeders), to cover perhaps 40 miles of track, one round trip per day. However, the power speeders get out of order and are dangerous, so that their present use is largely restricted to heavy grades or to wilderness territory where train traffic is light and other means of communication are largely absent. The next step in evolution was patrol by special men on hand velocipedes, one round trip per day on say 18 or 20 miles of track, or two round trips on 9 or 10 miles. There is a large mileage on which this form of patrol is in effect. More recently, there is a strong tendency for the fire patrol work to be handled on each section by a man selected from the section crew, provided with a hand velocipede and with standard fire-fighting tools. Considerably more than half of our railway patrols are now on this basis. The plan has many advantages: the men are practically permanent; there is always some one to make the patrol; responsibility is direct and supervision is much more feasible from the railway organization viewpoint; when patrol is not required, the labor is again absorbed into the section crew. Such patrols are made at times of day specified by the local officer of the Board concerned, who receives each week a diary of patrols within his territory. This form of patrol is the most reliable and most efficient we have, when made according to the requirements, and it is the business of the Board's local inspector to see that it is so made. Section forces must make a daily inspection of track for safety of train operation, and the fire patrol is often combined with this, thus reducing costs to a minimum. It is of course understood that special patrol is required only in territory where the fire hazard is considered to justify the same, and only duing such portions of the fire season as is made necessary by weather conditions, in the judgment of the local officer of the Board.

Thirty-four per cent of the railway mileage is in forested territory. On 7,203 miles some form of special patrol is prescribed under the Board's order. This represents special attention to fire patrol by 747 selected members of section crews, 65 velocipede patrolmen, and 59 power speeder patrolmen—a total of 871 special fire patrolmen on all lines. On 6,214 miles of forested territory where the fire hazard is not extreme, special fire patrol is not prescribed, the detection, reporting, and extinguishing of fires being left to section forces and other regular employees, as a part of their regular duties.

It is of interest to note that crude oil is in exclusive use as locomotive fuel on some 1,500 miles of railway in British Columbia. This has so nearly eliminated the danger of fires being set by railway agencies that in such territory, even though heavily forested, special patrol is not required, but the fire protection work is left to the ordinary attention of section forces and other regular employees of the railway, as described in the paragraph following.

9. All employees of the railway are required at all times to be on the lookout for fires burning along or near the track, and to report immediately any such found to section forces and to the nearest railway agent. Provision is made for immediate notification of the nearest forest officer, by telegraph or telephone. All section forces and other employees available are required to take immediate steps to extinguish fires, and provision is made for securing additional help when needed. The entire railway organization is thus made a part of the fire-fighting machine. The burden of proof is placed on the railway to extinguish any fires occurring within 200 feet of the track, unless it can be shown that they are not due to the railway. Thus, the rule is to get the fires out first, and then to discuss questions of reimbursement of costs from the local Forest Service, should there be occasion to do so in any case. As a matter of fact, the railways do extinguish a great many fires for the origin of which they are in no wise responsible.

In addition to the ordinary fire-fighting tools carried by patrolmen and emergency tools stored at section tool houses, the Canadian National and Canadian Pacific Railways have voluntarily provided a total of 28 fire-fighting tank cars, distributed at railway terminals in the more hazardous regions. These consist of large water tanks mounted on flat cars, with steam pump and a substantial supply of hose. This outfit is hauled to the fire by a locomotive, which also provides the steam power for operation of the pump. These outfits have been extremely useful on many occasions and have saved a great deal of forest and other property. A small beginning has also been made in the use by railway patrolmen and section forces of hand spray pumps with waterproof packsack attachment for carrying water. These are excellent equipment for controlling protective burning as well as for the suppression of accidental fires.

For the enforcement of the Board's order and the general supervision of the work of the railways under it, the Board's Fire Inspection Department has an extensive field organization covering forested territory along railways from coast to coast. This, however, is not a separate staff on the Board's payroll, but is developed under cooperative arrangements with all the existing forest services, Dominion and Provincial, under which selected officers of such service are given ex-officio appointments as local officers of the Board. There are 173 such appointments in effect in the Dominion Forest Service, the Dominion Parks Branch, and the forest protective organizations of the Provinces of British Columbia, Alberta, Saskatchewan, Ontario, Quebec, New Brunswick, and Nova Scotia. Taking the Ontario Forestry Branch as an example, the Provincial Forester becomes our Provincial Fire Inspector; each District Forester becomes our District Fire Inspector; and Chief Rangers on railway lines become Divisional Fire Inspectors for the Board. These men handle our local inspection as a part of their regular work, and have a considerable degree of discretionary authority as to granting of relief from special patrol requirements, issuance of permits to burn débris on right of way, etc., with a view to decentralizing the administration of the order. The object is to adjust the protective measures to the local conditions, and to make the expense proportionate to the fire risk

and possible damage; hence the need for a considerable degree of elasticity. In a number of cases, particularly of locomotive inspectors, the full time services of special men are provided by the cooperating organizations.

We thus have what is in effect a triangular cooperation between the Board, the Government Forest Services, and the railways. The managements of the railways are keenly interested in the work and have given it splendid backing, with the result that section forces and other employees, once largely indifferent with regard to forest fire protection, have largely become educated to their duties in this respect, and are doing really splendid work. In consequence, though fires still occur, their number is much reduced, and most of them are extinguished in their incipiency, so that the railways have become a minor instead of a major element in the destruction of our forests. The railways recognize that all this is good business practice, for many reasons: damage claims are reduced; present and future revenues from freight and passenger traffic incident to the forest industries are conserved; forest products for railway use are saved, in the form of ties, posts, poles, bridge timbers, lumber, etc; tourist traffic is increased where the forest is kept green, and towns and industries are kept going that can not exist where the forest is destroyed; thus population is built and maintained, and this is as much in the interest of the railways as it is in that of the country as a whole.

The fire record of the railways under the Board's jurisdiction is indicated in Table 1, showing comparative statistics for the past five years. The figures quoted are from official reports and show totals of fires reported and of areas burned over, the latter including considerable areas not actually in forest, although within territory broadly classified as forested and under protection by Governmental and private services. Statistics for strictly non-forest territory are excluded, such, for example, as agricultural and open prairie areas.

Thus for the five-year period, 1923 to 1927 inclusive, the railways are charged with 14.8 per cent of the fires and 4.5 per cent of the area burned. One-half of the fires attributed to the railways during this period were incipient, burning less than one-fourth acre each and causing no damage. Many of these are cases where section forces allowed clearing fires to spread slightly off the railway right of way.

In the four eastern forest provinces, 1923 was one of the worst fire years on record, while in the west conditions were fairly normal. During the succeeding three years, conditions were reversed, the west suffering excessively, while the east was normal or average. Fire losses go up or down with prevailing weather conditions, and this applies to railway fires as well as to others.

The statistics of railway fires for 1927 are the lowest on record. For this, the credit must be divided between generally favorable weather conditions and the increasing effectiveness of protective forces. The railways were charged with 396 fires in forested territory, of which 43 per cent were incipient and only 10 per cent exceeded 10 acres each in area. These fires burned over 436 acres of young forest growth, 412 acres of merchantable timber, 353 acres of slashing

or old burn not restocking, and 2,518 acres of permanently non-forest land (grass, swamp, muskeg, barren, cultivated land, etc.); total 3,719 acres, with total forest and other property damage estimated at $9,124.

Fires attributed to locomotives during 1927 comprise 75 per cent of the total number attributed to railways. These burned 78 per cent of the total area and caused 38 per cent of the forest and other property damage resulting from railway fires. Employee fires account for the balance.

TABLE 1

STATISTICS OF FIRES IN TERRITORY BROADLY CLASSIFIED AS FORESTED, FOR CANADA AS A WHOLE, IN COMPARISON WITH THOSE ATTRIBUTED TO STEAM RAILWAYS UNDER THE JURISDICTION OF THE BOARD OF RAILWAY COMMISSIONERS

	1923	1924	1925	1926	1927	Average, 1923-1927
Total number of fires, all causes	5,528	5,581	5,536	5,779	3,607	5,206
Total fires attributed to railway causes	861	963	695	931	396	769
Per cent of total number attributed to railways	15.6	17.3	12.6	16.1	11.0	14.8
Total area in acres burned by all fires	6,240,413	1,964,307	1,796,529	1,845,572	390,362	2,469,403
Total area in acres burned by fires attributed to railways	424,407	30,481	49,585	45,829	3,719	110,804
Per cent of burned area attributed to railway fires	6.8	1.6	2.8	2.5	1.0	4.5

BETULA CORDIFOLIA, A WELL-MARKED SPECIES IN THE LAKE SUPERIOR REGION

By C. O. ROSENDAHL
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IN SARGENT'S Manual of the Trees of North America[1] *Betula papyrifera* var. *cordifolia* (Regel) Fernald is described as a small tree seldom over 30 feet high. It is furthermore stated that on the mountains of New England it attains only the stature of a low shrub, and the same fact is noted both in Gray's New Manual[2] as well as in Rehder's Manual of Cultivated Trees and Shrubs.[3]

Regel's[4] original description of this birch was based on a collection by de la Pylaie from Newfoundland, preserved in the herbarium of De Candolle, but Regel committed the curious error of citing the collection as being made by "de la Tylaie in Novja Zemlaja."[5] Shortly afterwards he corrected this mistake and in his monographic treatment of the *Betulaceae* in De Candolle's Prodromus[6] he reduced the species to varietal rank as *Betula alba* Subsp. *papyrifera* *β cordifolia.*

From a piece of bark accompanying de la Pylaie's specimen Regel inferred, according to the comments following the formal diagnosis, that the species was a tree of considerable size at least for the purported place of occurrence—("scheint . . . . einen für jene Gegenden noch ansehnlichen Baum zu bilden"). In the Prodromus eight years later, under the new alignment already mentioned, he described it as a tree *probably of medium size.* Among the specimens examined at that time he cited one from the Pic River, Ontario, so that obviously he regarded the variety as ranging from Newfoundland to the Lake Superior region. A similar east and west range is given both by Sargent and by Rehder, but it is also stated to occur on Mt. Mitchell, North Carolina.

This birch is fairly common throughout northeastern Minnesota and in many localities of Cook County it is even abundant. Throughout its whole range in the state it is decidedly not a small tree. As a matter of fact a major-

[1] Sargent, C. S., Manual of the Trees of North America, Ed. 2, 213, 1922.

[2] Gray's New Manual, 335, 1908.

[3] Rehder, Alfred, Manual of Cultivated Trees and Shrubs, 141, 1927.

[4] Regel, E., Monographische Bearbeitung der Betulaceen. Nouv. Mem. Soc. Nat. Mousc. 13:86, 1860.

[5] Regel's error undoubtedly arose through the literal translation of the French Terre Neuve (or Latin Terra Nova) on the original label. I am informed by the Russian botanist Mrs. Helen Sorokin that these terms would normally be interpreted in Russia as referring to Novja Zemlaja, and it appears therefore that Regel, although a German by birth, followed the prevailing custom of the country in which much of his professional career was spent. That the mistake was an actual one, not the use of Novja Zemlaja in the sense of Newfoundland, is indicated by the context, the comparison of the birch in question to Siberian rather than American species, and the further fact according to Mrs. Sorokin that the Russians themselves use the English name for the American island rather than the Russian equivalent.

[6] De Candolle, Prodromus 16: Pt. 2, 166, 1868.

ity of the largest birch trees observed during the summer of 1927 near the International Boundary from Gunflint Lake eastward and on the Lake Superior slope from Grand Marais to the Pigeon River were *B. cordifolia*. Individuals with a trunk diameter of 16-24 inches and estimated heights of 60 to 75 feet are not uncommon. In some places *B. papyrifera* and *B. cordifolia* occur together but the latter was noted to be more abundant on the lower slopes of ravines, in canyons, and along streams, preferring moist situations generally, whereas the former predominates on the upper slopes and ridges. When found growing together the contrast between the two is very marked and there is never any doubt about their identity, not even among the young trees.

The most outstanding characters which differentiate *B. cordifolia* from its better-known congener are the manner of branching, the denser foliage, and the color and nature of the bark. There are also a number of important differences of detail which will be noted later on. The branches form a greater angle with the stem than in the common birch, the lower ones often standing out nearly horizontally. The result is a broad or ovoid crown in contrast to the narrow and more elongated form of *B. papyrifera*. The leaves are uniformly larger and whether or not they are more abundant at least they give the effect of denser foliage. The outside bark appears in general light gray but when matched with standard color charts it is found to be very pale orange to pale-orange yellow. (In Klincksieck and Valette's Code of Colors,[1] it varies between color patterns 153b and 153c.) On account of the marked tendency to peel freely and expose the deeper layers, the trunks and larger branches take on a decided copper or bronze color. According to the above cited Code of Colors the inner layers of bark vary from medium orange to medium red-orange, between color patterns 117 and 88. The exfoliating nature and the yellowish tinge of the bark combine to give old trees more the aspect of the yellow birch (*B. lutea*) than of the paper birch. If the bark of a fair-sized tree is slit quickly with a knife it snaps open with a distinct report indicating that it is under considerable tension. At the same time it separates into numerous thin layers and does not come off in firm, coherent sheets as is the case with the paper birch. This fact is probably the basis for the Chippewa Indians distinguishing between the "he birch" and the "she birch," one being suitable for canoe making while the other is not (presumably the *she* kind). The layers into which the bark mostly of its own accord separates are frequently of the thinness of writing paper and with a little manipulation layers measuring only 40-50 microns can be separated from each other readily.

A marked difference in the length of the lenticels of the two species was observed in comparing pieces of bark of *B. cordifolia* from the Superior National Forest with that of *B. papyrifera* from the region of Minneapolis. For this comparison pieces of bark of equal area from several trees of the same diameter and presumably of about the same age were chosen. It was found that in *B. cordifolia* over 12% of the lenticels attain a length of 30 mm. or more (occa-

[1] Klincksieck, Paul et Valette, Th., Code des Couleurs, 1908.

sionally up to 65 or 70 mm.), whereas in *B. papyrifera* only 2.5% reach a length of 30 mm. and very rarely were they found to exceed 35 mm. The average length of the lenticels in *B. cordifolia* was found to be 19 mm. and in *B. papyrifera* about 13 mm. Further comparison was made by plotting frequency distributions from equal areas of bark and it was found that the empirical mode of the curve for *B. cordifolia* is at 18 mm. and for *B. papyrifera* it is at 12 mm. It is recognized that the number of samples examined is too small to warrant any assertion that this difference is consistent and significant but at any rate it is striking in the specimens examined. In passing it may be noted that a piece of bark of *B. cordifolia* from Mt. Mansfield, Vt., shows the much elongated lenticels characteristic of the Minnesota trees.

The writer has observed on several occasions when using birch bark for starting the camp fire that the bark of *B. papyrifera* is much superior for kindling purposes to that of *B. cordifolia,* especially in wet weather. A chemical analysis [8] of the bark of the two species recently made showed that the amount of resinous oil in *B. papyrifera* is 31.72% of the total dry weight of the bark, whereas in *B. cordifolia* it is 28.20%. The inferior burning quality of the bark of the latter species must be due in part to this difference in oil content but perhaps mainly to its physical nature, the numerous thin layers, as already emphasized, opening up freely and thus permitting the water to penetrate readily.

[8] I am under obligations to Dr. R. A. Gortner, Chief of the Division of Biochemistry, University of Minnesota, for chemical analysis of the bark.

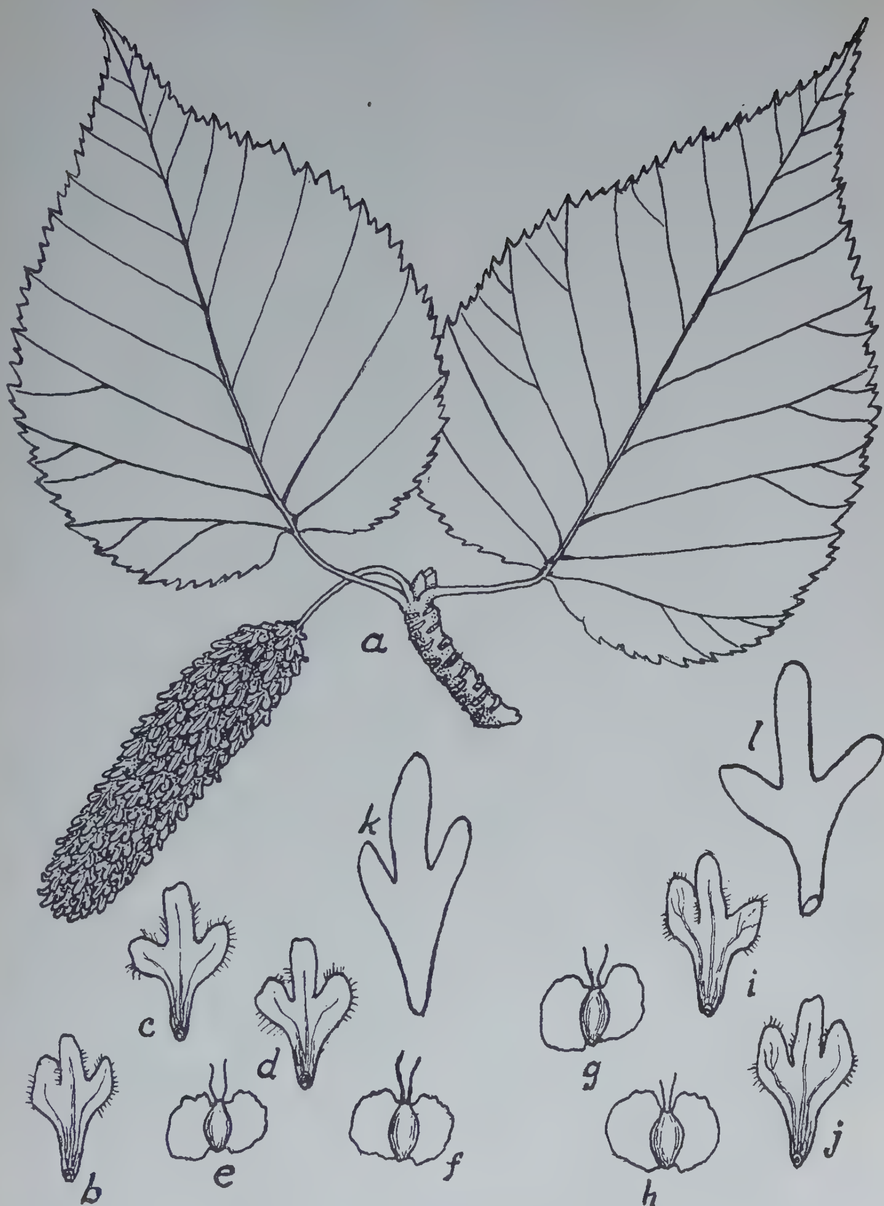
A phenomenon apparently of considerable biological significance was noticed throughout the region around Poplar Lake near the eastern border of the Superior National Forest where the two species of birch are common. In some localities practically all the individuals of *B. cordifolia* were attacked by species of leaf-rolling insects, one of which rolled the leaves from the tip or one side only, the other by folding the leaf along the mid-rib. At the time the observations were made the insects had all disappeared but a difference in the shape and size of casts indicated two different species of insects according to Mr. Leslie Orr, forest entomologist stationed at Poplar Lake. In no instances whatever were the leaves of *B. papyrifera* found to be affected.

These various characteristics, most of them so well marked when the trees are observed in the field, together with the distinctions noted and recorded by Regel, seem to constitute sufficient reasons for rehabilitating *B. cordifolia* to full specific rank. This standpoint is further supported by the fact that in the region where it occurs interspersed with the other species no intermediate or intergrading forms have been detected.

Having passed almost from the first as a variety of *B. alba* and *B. papyrifera* the descriptions accorded it are very brief and inadequate for which reason a full description is appended.

Betula cordifolia Regel Nouv. Mem. Soc. Nat. Mousc. 13: 86, T. 12, 29-36, 1860.

Betula alba Subsp. 6, *cordifolia* Regel. Bull. Soc. Nat. Mousc. 38: pt. II, 401, 1865.



Betula cordifolia: *a,* fruiting branch, natural size; *b-d,* fruiting scales, enlarged about $2\frac{1}{2}$ times; *e-f* samaras, same magnification, all from a specimen collected at Grand Marais, Minn.; *g-j* samaras and fruiting scales from a specimen collected in Gaspé County, Quebec; *k-l,* fruiting scales copied from Regel's original plate.

Betula alba Subsp. *papyrifera* β *cordifolia* (Regel). De Candolle Prodr. 16: pt. 2, 166, 1868.

Betula papyrifera var. *cordifolia* Fernald. Rhodora 3: 173, 1901.

A medium-sized to large tree 12-25 m. high and a trunk diameter up to 7 dm., with an ovoid, rather dense crown and spreading branches; bark of trunk and main branches very pale orange to pale orange-yellow, separating freely into thin, tough, papery layers, giving the trunk of the larger trees a very ragged appearance, inner surface of the separating layers of a pronounced coppery color (varying from medium orange to medium red-orange); lenticels narrow and often much elongated (30-60 mm. long); buds ovoid to elliptic-ovoid, blunt, 4-6 mm. long, the scales resinous along their margins or over the whole outer surface; twigs at the end of the first season yellowish-brown to chocolate colored, marked with numerous elliptical to orbicular light-gray lenticels and dotted with resinous glands, sparingly pubescent or glabrate, older twigs with a gray-brown lustre, the lenticels becoming very conspicuous; leaves ovate, 4-9 cm. long, 3-7.5 cm. wide, cordate to subcordate at the base, acuminate at the apex, with 7-9 pairs of lateral veins; margin doubly or sometimes irregularly serrate, dull green and glabrous above or with a few long pale hairs along the veins, with tufts of shorter stiff hairs in the axils of the lowermost veins, dotted all over with numerous, small, resinous glands; petiole rather stout, 1-2.5 cm. long, sparingly villous or glabrate; staminate catkins from the end bud, usually in pairs; pistillate catkins from short, lateral spurs, in fruit becoming 4-6.5 cm. long and 11-14 mm. in diameter, drooping, pedicel 1-2.5 cm. long, fruiting bracts 6.5-8-5 mm. long, deeply 3-lobed, the middle lobe narrowly oblong and generally much longer than the ovate, strongly ascending lateral lobes, margins of the lobes ciliate-pubescent; samaras 5-6 mm. wide; nutlets elliptic to narrowly obovate, 2.2-3 mm. long, 1.2-1.8 mm. wide, narrower than the wings of the samara; persistent styles 1.8-2-3 long.

Aside from the typically heart-shaped leaves *B. cordifolia* shows little or no tendency towards the lobing or double serration of the margin which is characteristic of *B. papyrifera.* The fruiting scales are considerably larger, with a narrowly oblong middle lobe which does not taper from the base as in the other species. The nutlets are longer and elliptic in shape and the styles are more than twice as long as in *B. papyrifera.* The accompanying drawings, made to the same scale with a camera lucida, bring out these various details.

STAINING LIVING TREES ON THE STUMP

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IN THE years 1924 and 1925 the Brown Company made careful experiments in the art of staining the wood of living trees on the stump, and took out a number of patents on the processes. Data gathered in these experiments may be of interest to foresters. No claim can be made for originating the basic idea, as the introduction of dye into trees was accomplished centuries ago, and German chemists, who recently claimed credit for bringing the idea to America, were merely reviving discoveries already known. In America, in fact, U. S. Patent No. 952,245, issued on March 15, 1910, to Levi S. Gardner, specified:

> The art of coloring wood which consists in inserting in tissues of the living tree coloring matter capable of distribution by the natural circulation thereof and of effecting a substantial change in the color of the tissues with which it comes in contact, and permitting such coloring matter to be distributed by the natural circulation of the tree.

Patents have been issued in America and Canada on the process and dyes used. The process experimented with by the Brown Company involves a method of cutting through all the sap wood of the tree close above the roots in two planes, one a foot above the other, in the following manner: A three-quarter inch hole is bored completely through the tree in each plane—one hole at right angles to the other. By means of a thin two-edged saw introduced into the hole, the tree is cut through one-fourth its girth to either side of the hole. If similar cuts are made from the hole in the plane above and at right angles to the first, all the conducting cells can be severed, but the tree will still stand. A diagonal hole is bored to connect the two cuts. The four saw scarf slits are calked with oakum from the outside and the four auger holes plugged. Then the dye is run into the diagonal connecting hole through a rubber hose, by gravity from a twelve-gallon can of dilute dye hung on the tree above the cuts. This dye takes the place of the sap which is ascending from the roots (being a reverse process to that of tapping a tree for maple sugar). Connection between the tube from the can and the diagonal hole is through a glass tube inserted in a hollow rubber stopper. The dye flows into the tree along the horizontal saw cuts and reaches every severed upward-conducting cell. The dye is absorbed and every part of the living wood in the tree is dyed. The heart wood being dead wood naturally does not take any color.

It was found that the saw cut process was expensive, due to the leakage of dye through the loosened calking when the tree swayed in the wind, and also that the coal tar dyes used were unsatisfactory for many reasons. Experiments led to the invention and patenting of an improved process of boring. This process overcame the objections of other methods up to that time used, by allowing the introduction of the dye with economy, completeness, and speed. New strains were discovered also that were superior to the coal tar dyes. These

stains blended with the sap, did not separate in the tree, were fast, insoluble, and colors were obtained to simulate other valuable woods.

During the experimental period in tracing the action of various dyes in living trees, many interesting facts were gathered, among which may be mentioned the following:

1. Gravity had little effect on the dispersion of the sap, and trees bored 20 feet in the air were colored above at the same speed as below the incision.

2. The movement of the dye was directly dependent upon the leaves, being coincident with the season of the year in which the leaves were active, and reached its maximum at the time of their complete development. It was dependent during the day upon the amount of transpiration from the leaves due to sunlight and wind, the most sap movement occurring in bright sunlight with a strong wind.

3. The dye ascended the bole of the average tree at the rate of five or six feet per hour, and a period of two or three days was sufficient to dye all the live wood of the largest hardwoods.

4. The dye descended into the roots, which were dyed as completely as the rest of the tree, but there was no absorption through the soil from the roots of one tree to another, except where there was actual root connection. A beech which sprouted from the roots of a dyed tree, was also dyed.

5. When using the former methods the dye as it ascended the vessels slowly permeated the cell walls, and fanned out as it approached the top of the tree, due to the pattern of the boring in the base. It is surmised that this absorption through the cell wall forms the process used by some other recent experimenters, but it is a slow and incomplete method. By the use of sundry colored dyes introduced in various parallel borings, interesting "barber-shop sign" effects were produced for a certain distance up the tree before fanning out took place.

6. The sap had selective qualities to separate certain aniline dyes into component primary colors when these dyes were themselves the result of a combination, and this separation took place before the dye reached the branches.

7. Certain dyes faded, and other dyes washed out.

8. A felled tree retained its vitality for a time sufficient to carry the stain from its severed butt, and a horizontal position made little difference, provided the leaves were free to act.

9. A softwood tree took dye equally as well as a hardwood tree, but the high percentage of heart wood made the staining of little moment commercially.

Experiments were conducted in boring with an electric drill and a machine was invented to simplify this process. Electricity for this purpose and for pumping water was generated by means of a modified gasoline fire pump equipped with electric generator.

Generally speaking, the whole cost of this process is not great. In trees with a small amount of heart wood, such as paper birch, the process is especially desirable, as there is little uncolored wood when treated logs are cut up into lumber. In yellow birch, maple, and beech, which contain a considerable percentage of heart wood, the cutting of the treated logs into lumber will have to be done with care and judgment, to produce boards that are stained throughout. Care

must be exercised in staining the tree that all actively conducting tissue is severed by the borings and that all severed ends have access to the dye; otherwise, there will be streaks of white in the lumber produced.

Many favorable comments have been received on the possibilities of use for such colored wood. It should have a wide market in interior finish, flooring, radio and graphophone sets, automobile steering wheels, and window strips, railroad car seat arms, and places where continuous wear exposes surface-stained wood. A great number of colored novelties can also be produced out of the small blocks cut in making the above mentioned articles.

INTERRELATION OF TREE-KILLING BARKBEETLES (DENDROCTONUS) AND BLUE STAINS

By F. C. CRAIGHEAD

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SEVERAL species of the genus *Dendroctonus* are quite properly recognized as the most important insect enemies of our coniferous forests. They annually destroy great quantities of timber; in most instances timber that to all appearances was healthy and vigorous and that would have lived for many years if these insects had not attacked it. The parent beetles attack gregariously, boring through the bark and constructing straight or meandering egg galleries in the phloem. It is well established that the development of their progeny depends almost entirely on the success of this initial attack in quickly overcoming the resistance of the tree. In other words, the rapid death and characteristic subsequent changes in the tree furnish the rather exacting conditions necessary for normal brood development.

The question of how these beetles kill the trees so completely and quickly is one that has attracted the interest of all those familiar with their habits. The usually accepted theory (2) that death of the tree is the result of the complete girdling of the cambium and phloem by means of the egg tunnels made by adults and the larval mines does not seem to be a wholly adequate answer. This rapid death can be illustrated by a comparison as follows. Trees attacked by the summer generations of some species of *Dendroctonus* may show fading foliage within three weeks after attack, while trees mechanically girdled by removing the bark from portions or the entire main stem may live from six months to a year or more and continue to add annual layers of wood on those portions above the girdle.

The invariable association of certain wood-staining fungi, the so-called "blue stains,"[1] with *Dendroctonus* attack has suggested to the writer that these fungi are probably introduced under the bark by the beetles in their attack and play an important rôle in the death of the tree. The blue stain develops very rapidly after the beetles attack and quickly permeates the sapwood along the medullary rays (4). Observations indicate that the tree is killed by the interruption of the ascending sap stream. It would seem that this might be accomplished by the action of some toxic secretions of the fungi destroying the living ray tissue of the main stem or affecting the normal functioning of the leaves in transpiration. It may also be that the rapidly developing hyphæ are instrumental in bringing about a clogging of the tracheids.

Furthermore, it is suggested that these fungi may be instrumental in conditioning the tree so that the proper medium necessary for the normal development of the barkbeetle broods is obtained, both by affecting the physical environment and possibly furnishing essential food requirements. That the physical environment necessary for optimum brood development is very exacting is amply attested

[1] *Ceratostomella* sp., determined by Dr. Caroline Rumbold.

by instrumental records and by unsuccessful efforts artificially to reproduce these conditions by numerous methods of treatment, such as seasonal felling, bark stripping and ringing, burning, etc. As to food requirements it is well known that the closely allied ambrosia beetles entirely depend on specific fungi for their food and normal growth (3) and that many insects that feed on dead vegetable matter require certain yeasts or possibly vitamines for normal development (1). An analogous case can well be postulated for these beetles. Briefly stated, there may be a true symbiotic relation between these beetles and these fungi.

Many observations and experimental treatments tend to support this theory. Characteristic moisture changes take place in the stem of the dying tree. The main trunk and upper portions of the tree progressively lose moisture while the water content of the basal portion, below the lower limit of attack and blue stain development, increases after attack. Treatments aimed at increasing the water content of the stem, such as defoliation or supplying copious water to the roots, tend to check development of both the blue stain and the beetles. Many observations indicate that there is apparently a very close association between development of the barkbeetle broods and the presence of the blue stains, and both of these in turn are concomitant with lowered moisture content of the trees. Münch, and certain other European workers, believe that some of these fungi are weakly parasitic when the water content of the wood is below normal.

This statement is presented for the purpose of stimulating further thought and investigation of this interesting problem. Several investigators in the Bureau of Entomology and Bureau of Plant Industry, U. S. Department of Agriculture, are working on the problem, and it is hoped that a fuller understanding of the relationships of these organisms will be forthcoming.

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A PRELIMINARY STUDY OF BORER DAMAGE IN STACKED WHITE PINE LUMBER

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IN THE late summer of 1925, a local wood-using concern suffered considerable loss from borers in white pine plank stored in two of its yards. In one lot fifty thousand board feet showed a loss of one-third at the end of the second summer. In another, also held over into the second year, a loss of fifteen per cent of the volume amounted to $818. This disregarded the depreciation in price due to lowered grade. The one company lost several thousand dollars during the season from this cause. In another yard where the plank had been stacked three seasons, local buyers refused to take twenty thousand feet at any price.

In view of these facts a short study was made, attempting to find the cause and extent of this extraordinary outbreak, and, if possible, some means of controlling the insect responsible for the losses. Nine yards with stacked lumber of known history were studied. These were scattered over the towns of Athol, Winchendon, and Ashburnham, Massachusetts, and Fitzwilliam, New Hampshire. A general description of each yard and a detailed description of each pile in which damage could be found were obtained.

Appreciable damage was found in six of the nine yards visited. In some cases only part of a small yard would be infested, while in others the uniformity and thoroughness of infestation were remarkable. It soon became apparent that two species of insect were present. The larvæ of both species were identified by Dr. F. C. Craighead, of the U. S. Bureau of Entomology. The smaller form, which was of little importance, was determined as *Callidium antenatum* Newm; the larger as *Monochamus scutellatus* Say. Due to the little damage done by the smaller, no further study was made of its habits. The following discussion, except where noted, deals with the larger, more injurious species, the pine sawyer.

The life of this insect has in it some vulnerable points on which control can be based. The adult beetles begin flying in this region about May 15. The female lays eggs in the bark of logs or round-edged plank by gnawing a pit through the heavy, outer fibers of the bark and inserting the eggs between the softer, inner bark and this heavy layer. The requirements of the species as to the moisture content necessary for incubation are very exact.[2] The grub, or larva, hatches in a few days (twelve in a laboratory test under conditions as nearly normal as possible). It immediately begins eating away the inner bark forming the characteristic chamber beneath

[1] Acknowledgment is due Dr. M. W. Blackman, Department of Forest Entomology, New York State College of Forestry, Syracuse, N. Y., for suggestions on control, and Mr. H. J. MacAloney, Assistant Entomologist, Northeastern Forest Experiment Station, for aid given throughout the course of the study.

[2] F. C. Craighead.

it. The "sawdust" is pushed out through a small hole in the outer bark. After it has grown considerably the larva begins to tunnel into the wood. Here in the north the grub usually lives through the first year in this tunnel, lengthening it down as far as the heartwood and then paralleling the bark for a few inches. Some time, usually in the second season, the larva bores a round exit hole one-fifth to one-fourth of an inch in diameter nearly out to the inner bark. It then retires to the deeper tunnel and sheds its skin, changing into the resting or pupal stage. It now goes through another change of a more gradual nature and completes the cycle by becoming an adult beetle. It finishes the round hole for emergence through the bark and comes out ready to feed and start another generation during the twelve to twenty days of its remaining life. The length of the complete cycle varies from one to three years (1).

It soon became apparent that the factor which governed the location and amount of damage in a given stack of plank was its dryness at the time of flight and egg-laying of the insect.

The distribution of damage in the stack was usually limited to layers two to five from the top. A very heavy infestation in lumber sawn during the season of greatest damage is necessary to spread the zone to anything like half of the pile. In a few piles where grass and weeds grew up around the bases, another region of light damage was found near the ground. This zoning might be explained as probably due to the fact that material with a very definite percentage of moisture is selected for oviposition by the adult beetles. With this moisture during the drying season always greater at the bottom and gradually lessening toward the top of the pile, only a narrow band of plank is in just the right condition at any one time. The lower infested area may be due to a later flight and egg-laying period of the same species, or to the attack of an allied form.

Variations in several other factors taken into consideration seemed to have no appreciable effect on the infestation. In this locality the egg-laying period is over by September 1, and possibly much earlier. In plank sawn after this and prior to March 1, the damage was negligible. The three yards in which no damage was found had their lumber sawn during this period. In other yards the piles sawn before March 1 were free from infestation, while those sawn later were well riddled. In one case where four rows of piles had been sawn and stacked during a three weeks' period in April and May and not arranged in order, the writer, without being given any previous hints, was able to decide the order of sawing from the amount of damage found. The piles in the rows first sawn had an average of 1.8 layers infested; the second, 3.6; the third, 4.2; and the fourth, 16.0.

Studying the piles in all yards by groups according to the month of sawing and averaging the corresponding numbers of layers damaged gives a very good illustration of this relation of drying to infestation. The following table is a summary of these figures separated into groups for the two thicknesses of plank.

The thicker plank is, because of its greater moisture stability, a better breeding ground than the thinner one.

Time of sawing	2-Inch Plank: No. of piles	2-Inch Plank: Av. no. of layers damaged	2-Inch Plank: Combined thickness of layers damaged	3-Inch Plank: No. of piles	3-Inch Plank: Av. no. of layers damaged	3-Inch Plank: Combined thickness of layers damaged
Nov.-Feb.	22	0.9	1.8″	87	0.3	0.9″
March	102	...	...	11	2.1	6.3
April	48	1.0	2.0	30	3.2	9.6
May	...	...	...	100	5.2	15.6
June	5	5.4	10.8	14	4.1	12.3
July	14	4.0	8.0	...	...	...
Sept., Oct.	30	...	...	...	...	...

This is shown by the figures in the table showing the combined thickness of layers damaged.

Shown graphically, the figures of the above table are still more striking. The "peak" of greatest damage formed in the two curves centers on the period of May and June. (See Figure 1.)

From this evidence it is quite safe to say that sawing between September 1 and March 1 will eliminate the damage without further control measures. The company first mentioned in this article, therefore, has limited the time of sawing of its plank by contract with the mill men to the winter and spring months before April 1.

If sawing cannot be finished in time to dry the lumber before the flight season of the insect, there are still controls,

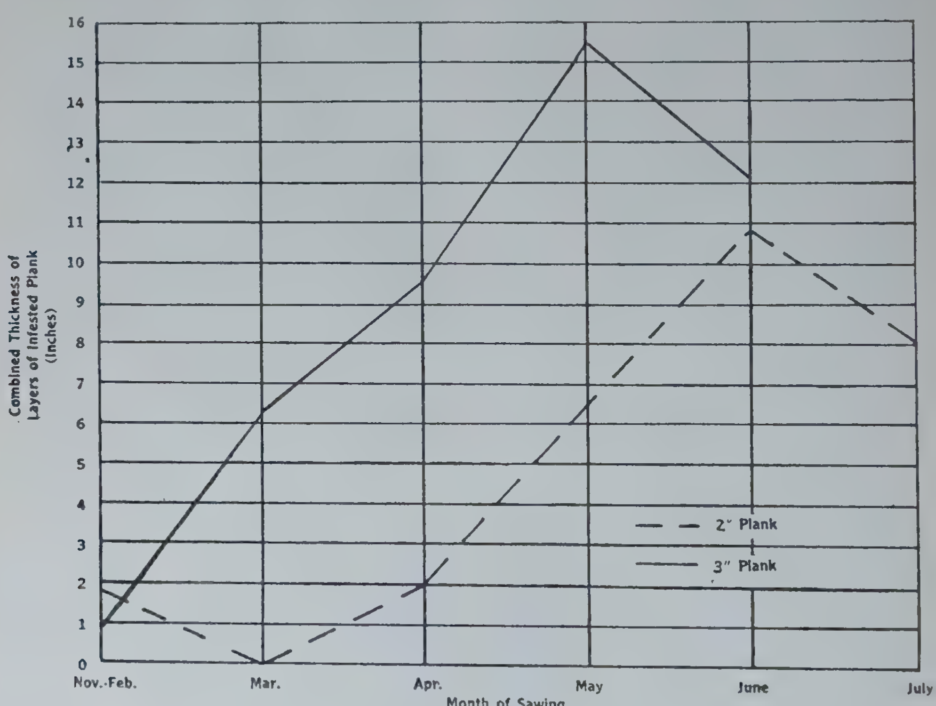

FIG. 1.—Relation of Month of Sawing to Amount of Damage.

but they entail extra work. One solution is, of course, sawing only square-edged lumber. Another is kiln drying at a temperature high enough to destroy any insect life and to dry the lumber so it is safe from further infestation. If the "sawdust" begins to appear in the piles the summer following sawing, the plank can often be made up into the finished product at once and before the larvæ have bored deeply enough below the bark to cause serious loss.

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RELATION OF FOREST MANAGEMENT TO THE CONTROL OF WHITE PINE BLISTER RUST

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Introduction

WITH the discovery on September 30, 1927, at a point seven miles north of Priest River, Idaho, of the uredinial and telial stages of the white pine blister rust on leaves of the white-stemmed gooseberry, there developed simultaneously among the foresters and lumbermen concerned in the future growth of timber in the Inland Empire an absorbing and ever-growing interest in the problem of control. The rust had at last reached us after a slow spread from Vancouver, British Columbia, where it was introduced in 1910 on shipments of white pine (*Pinus strobus*). During this period, the various federal, state, and private interests cooperating in the Northwest and Pacific Coast regions have been steadily gathering data on the fungus and its hosts, devising methods of control and improving control measures, as well as reducing the control costs per acre.

Studies conducted by the Spokane Office of Blister Rust Control have yielded, among many others, some valuable data on the life history of individual species of Ribes. These data are gradually pointing the way to practical control measures in the face of a complexity of factors which makes blister rust one of the most difficult problems in the history of the western white pine belt.

The forests of northern Idaho are teeming with several species of wild currant and gooseberry, and along the stream beds solid masses of these plants flank valuable and extensive white pine forests. Fortunately, not all of these alternate hosts of the rust are as effective in developing and spreading the disease as is the cultivated black currant, which has been practically eliminated from Idaho and neighboring states. In many forest areas, we are unable to find the wild Ribes developing in dense stands or on cut-over or burned-over areas. Such facts, along with many more, encourage us in the belief that effective control measures based on the eradication of the Ribes species are practicable. They also indicate that much may be accomplished by methods of forest management which discourage the development and establishment of wild Ribes in the white pine stands of the future.

The major responsibility for setting the pace in blister rust control in Idaho would seem to rest upon the Federal Government, since the Forest Service controls over 57 per cent of the total forest area of northern Idaho. Although controlling 53 per cent of the total white pine in board feet on this area, the private owners hold but 34 per cent of the total area of forest land north of the Salmon River. The State of Idaho holds but 6.2 per cent of this total forest area, and this includes only 16.6 per cent of the white pine in board feet. However, the State's duty is no whit reduced on this account, and it should protect its timber against the rust. This step has already been taken by Idaho, in coopera-

tion with the Office of Blister Rust Control, and control work on a large scale is planned.

Selection of Control Areas

At the outset, it is obvious to all of us that the entire forested area of northern Idaho, covering 25,754,000 acres, cannot be included within a control area. The job would be too huge and too costly, and we should be spending money protecting large units of forested land upon which the total present or future values of white pine would be so small that the expenditure of control money would not be justified. The choice of areas needing protection, therefore, must be made (1) from areas including commercial stands, and (2) from areas including reproduction stands. The protection forests, inaccessible and containing but small quantities of white pine, and those agricultural and grazing areas found within forest lands need not be included in the areas needing protection. In northern Idaho, the forests containing commercial sized timber cover an area of 4,060,000 acres,[1] or 38 per cent of the total forest area north of the Salmon River. The reproduction forests cover 4,683,000 acres, or 43 per cent of the total forest area north of the Salmon River. The two areas total 8,743,000 acres of forest land. Within this area, there are 2,655,372 acres of western white pine type of forest containing 13,534,000,000 board feet of western white pine and representing 26.4 per cent of the total board foot stand of all species. Western yellow pine represents 10.8 per cent, larch and Douglas fir 28.1 per cent, and the other species including the true firs, hemlocks, and cedar 34.7 per cent.

Factors in the Reduction of Total Area Needing Protection

As previously stated, the area containing commercial sized timber in northern Idaho covers 4,060,000 acres. To those who are striving to protect western white pine against the rust, it is heartening to find that there are several factors in the process of classifying these areas which will aid us in paring this acreage down to a less formidable figure.

Data collected by the Spokane Office of Blister Rust Control indicate that in mature or nearly mature well-stocked stands the Ribes population reaches its minimum density. So long as no appreciable openings occur in the stand there will be very few if any Ribes plants flourishing. Little or no control is needed on such areas, and they may be excluded from the protection areas. The classification is complicated, however, and the need for control is most pronounced in regions where forest density is great, but where the streams within the drainage support a large number of Ribes plants, particularly of the wild black currant. It has been roughly estimated that from 60 per cent to 85 per cent of the mature stands are practically Ribes free.

The total area of commercial sized timber needing protection is further reduced where single burns of sufficient intensity have occurred so that the burned areas have been made practically Ribes free by destroying the Ribes seed in the duff and the plants and root stalks present on the area before the fire. This statement needs to be qualified, however,

[1] Idaho Forest and Timber Handbook. University of Idaho Bulletin, Vol. 22, No. 22, pp. 1-155, August, 1927.

for on portions of the burn, usually at the margins, where only part of the duff is destroyed, there may appear the following fall or spring large numbers of Ribes seedlings. On areas where double, triple, or a greater number of burns have occurred at intervals, which were effective in destroying such Ribes as developed on the partly burned sections of the previous burn and which killed the Ribes plants before new fruits were produced, the Ribes population has been reduced to a negligible quantity. Areas heavily burned or burned more than once at favoring intervals have few if any Ribes plants and represent an area where control is unnecessary or where protection costs are extremely low. On such areas, the planting of white pine is often the only means of reestablishing a white pine stand, and such a procedure may be encouraged since the danger of rust infection is small and the cost of protection, if any, is low.

Forest Management as an Aid to Control

The facts so far obtained indicate that the forest area needing protection can be greatly reduced:

1. By considering only the most valuable areas bearing merchantable and reproduction stands of white pine.

2. By the gradual elimination of Ribes species in mature or nearly mature well-stocked stands.

3. By single burns of sufficient intensity, with the exception of margins.

4. By double burns or recurrence of fires at intervals favoring the elimination of Ribes.

The data accumulated also indicate that as a well-stocked stand increases in age from 30 or 40 years on, there is a definite tendency for the Ribes population to decrease in number and in infecting power, thus reducing control costs on such areas to a minimum. The only control costs, therefore, on such areas are those caused by the Ribes concentrations along streams, and this cost is distributed over the timbered area protected. Fortunately, the Spokane Office has found an effective control method for such areas in the chemical method of Ribes eradication.

Since fire in general increases the blister rust hazard by reestablishing the Ribes plants on the same areas where white pine reproduction is developing and a closed stand *reduces* this hazard appreciably, we have a combination of facts which point directly to a method of logging that favors residual stands and a minimum disturbance of the forest floor. This, also, furnishes an additional reason, if any be needed, for suppressing fire. That these requirements go hand in hand with better forestry practice, and at the same time are of promising value in the control of blister rust, is of prime interest to foresters and lumbermen.

Although mature and nearly mature well-stocked stands show an absence of Ribes any appreciable disturbance of the conditions which brought about the gradual elimination of the Ribes plants has usually resulted in restoring these plants on a rather alarming scale. Fire, insect and fungus attack, logging operations, and construction work, such as highway and railway operations, have been observed to cause this abrupt change from an almost total absence of Ribes in the undisturbed stand to a crop of seedlings running into the thousands per acre on the disturbed areas.

On burns and logged off areas, where Ribes appear in large numbers soon after the fire or after logging, the cheaper plan would be to delay eradication until the third or fourth year. By that time the number of Ribes plants that survived will be but a small per cent of the original number. However, the eradication should be done just before the Ribes plants begin to produce fruits. One re-eradication may be necessary as a follow-up. Such a plan would soon develop a comparatively Ribes-free area, since the seed producing the Ribes seedlings all germinate within the year following the fire or logging, and unless new seeds are produced on the area, the chances for the reestablishment of this species of Ribes are small.

It is, therefore, evident that a residual stand of fair density, where logging has disturbed the forest duff but little and where brush burning has been carefully completed, represents an area which may need less protection or where cost of protection will be less than on a clear cut area. On the other hand, disturbance of duff by logging operations, medium to light burning of duff in brush disposal or on burns, and the removal of timber stands all favor the return of large numbers of Ribes seedlings. Any change in these factors resulting in the suppression of Ribes plants favors protection and reduces protection costs.

To gain some idea of what may be expected of a residual stand, both as to yield and density of cover, I should like to quote from a commendable piece of work done by H. I. Nettleton of the Idaho School of Forestry.

Plots were laid out upon an area logged in 1907. A typical acre on this area, measured eighteen years later, showed that about 25,000 board feet were removed from it at the time of logging. On the acre were left 42 western white pines averaging 80 years of age and with an average diameter of 6 inches. In 1925, eighteen years later, these same trees averaged over 10 inches in diameter and scaled 4340 board feet. They had increased 75 per cent in diameter, 40 per cent in height, and 267 per cent in board foot volume, or an average of 175 board feet per acre per year.

In addition to the white pine yield, the area showed 2700 board feet of residual white fir and 2300 board feet of residual Douglas fir with a third crop advancing under the residual stand.

During the summer of 1926, a reproduction study of all species, including all trees up to 2 inches in diameter, was made on eleven residual plots on this same area, and gave the following figures per average acre:

Species	No. of trees	Per cent of total
Western white pine....	642	6.0
White fir	8,229	77.2
Douglas fir	562	5.3
Lodgepole pine	312	2.9
Western red cedar.....	235	2.2
Engelmann spruce	85	0.8
Western hemlock	264	2.5
Alpine fir	261	2.4
Larch	62	0.6
	10,651	100.0

Since a well-stocked area may be represented by a covering of 1000 young trees per acre, it is readily seen that the density of a residual stand such as this one (over 10,000 trees per acre) may greatly favor the elimination of Ribes. There is, however, one consideration which must not be overlooked, and that is the even or uneven distribution of these seedlings or young trees over the area. It is plain that

many openings in an otherwise dense stand would increase the Ribes population and be less favorable to our control plan.

Since the density of reproduction stands and residual stands plays such an important part in the return of the Ribes plants to the burned-over and cut-over areas, the areas of reproduction forests containing merchantable quantities of white pine will demand a good share of attention in any control program agreed upon.

The virgin stands of Idaho are being depleted at the rate of 1,467,000,000 board feet per year. In northern Idaho we are removing annually about 633,000,000 board feet through the cutting of saw logs, 546,000,000 board feet through fire losses, 105,000,000 board feet through insect attack, and 15,000,000 board feet due to decay in the standing timber. All of these losses, with the exception of decay, result in the establishment of reproduction areas, a good percentage of which may come into white pine and all of which may support many Ribes plants per acre. In any plan of control, such facts must be taken into consideration. In northern Idaho forests, the present reproduction area represents 47 per cent of the total forest area, the merchantable timber 40 per cent, and the protection forests 13 per cent. As logging and forest fires remove an increasing total of timber from the merchantable forest areas, the areas of reproduction forest will increase in somewhat direct proportion.

This is an angle which must not be overlooked and is closely related to the rate at which the commercial timber on the private holdings is being removed. The private lands comprising but 17 per cent of the total forest area of the state and containing 30 per cent of the standing timber furnish 72 per cent of the total annual cut. It is estimated that 30 years will see the virgin timber on the private holdings completely cut out. This will mean that at the end of 30 years the private holdings in the northern forest area will have their acreage of reproduction forests increased by nearly six and a half million (6,449,800) acres due to cutting operations and over five and a half million (5,569,200) acres due to fires. The figure for the area reduced to reproduction by fire is undoubtedly high since average fire losses for the entire northern Idaho area were used in computing this estimate and the fire losses on the more accessible private holdings are usually less than on the federal and state lands.

In attempting to classify the young white pine growth with any reasonable certainty that the areas selected will in the future yield sufficient merchantable white pine to make logging profitable, we are confronted with our most difficult problem. For example, we have no volume or yield tables applicable to the younger stands or reproduction, 0 to 30 years old, to guide us in classifying such areas. It is important, however, that we have some unit of measure to apply to these stands; a measure which will determine the minimum percentage of white pine seedlings, saplings, or poles per acre that will yield a merchantable cut at maturity, thus determining the areas upon which it will pay to expend money for blister rust control. The rust has already entered Idaho forests and it would be near-sighted policy to delay a control plan five years, awaiting sufficient experimental data to supply the

needed yard stick. Would it not be more practical to agree upon some arbitrary method of classification for these stands, and revise this method as new data are obtained?

In planting western white pine on denuded areas, a 6 x 6 foot spacing gives us 1200 seedlings per acre. If we allow for a loss of 200 seedlings per acre during the period of establishment, we can figure on 1000 established seedlings per acre. This would give an average of 1 seedling per milacre and would represent a fully stocked area. Should we decide that 10 per cent of a fully stocked acre of mixed seedlings constitutes the minimum amount of white pine seedlings 0 to 5 years old, that, then, would give us 100 white pine seedlings per acre. We would next have to consider the minimum per cent of white pine seedlings per acre agreed upon as a basis for classifying reproduction areas that are not fully stocked. And we must determine as well the minimum density requirement on such areas. Obviously it will be cheaper to practice control on well-stocked or fully stocked areas where the chances of crowding out Ribes by natural means are greatest. The plan of appraising the areas of reproduction on the basis of what these lands produced in the past is also worth considering.

Many Problems Unsolved

Thus far, I have merely introduced the main problem. The various factors that influence the return of Ribes species to the area have already been mentioned. There are in addition a large number of unanswered questions bearing on the entire problem. For example, what do we know about the length of time Ribes seeds will remain viable in the duff? Is it the refrigerating condition found in the moist, shaded duff that prevents these seeds from germinating before the duff is partly removed and heat reaches the viable seeds?

How many of the thousands of Ribes plants per acre appearing after a burn live through the third or fourth year? What are the factors affecting this survival? How old must a Ribes plant be before it produces a crop of seeds?

The prevailing and proposed methods of slash disposal must be studied in relation to the control problem as a whole. If brush burning causes a crop of Ribes plants to appear along the margins of the burn, how can the burning be done to prevent this? And is it desirable or economic to change the method? If the relatively small percentage of Ribes seedlings is readily found by eradication crews on brush burns and skid trails and if but few seedlings survive, will this reduce the control cost in comparison with the increased cost and difficulty of removing Ribes seedlings scattered over the entire area?

Another question of vital importance to the control plan is that of the effect of duff removal or disturbance upon the germination and establishment of white pine seedlings. Do the duff conditions which favor the return of white pine on the area also favor the return of Ribes seedlings and to the same degree? How can we favor the return of white pine seedlings and at the same time discourage or prevent the return of Ribes? It may be that this phase of the problem will demand the major part of our attention in our attempt to make forest management bear its share in the control of blister rust. The question then arises—

how important is forest management in the Idaho white pine belt, and to what extent may it affect the control plan?

The federal and state acreage in northern Idaho represents 6,876,000 acres, and this is the total area in the white pine region which can be considered under forest management with sustained yield as the objective. This represents 26.6 per cent of the total forested area of the state and 63.5 per cent of the total white pine area of northern Idaho. To this may be added some 500,000 acres of private holdings controlled by three large private operators who are, at this time, considering the possibility of forest management. Every effort should be made to establish some form of sustained yield management on these private holdings, since the privately owned timber lands in the white pine belt are the most valuable as well as the most accessible and, therefore, represent some of the best areas for the future growth of western white pine.

If western white pine, which is said to be several times more susceptible to the rust than eastern white pine, is to remain a lumber producing species in Idaho and the adjoining regions, it must be protected against this destructive disease. The "if" is intentional, for some will argue that the species may not be worth the effort, and that the secondary species can later fill the gap. Let us not make the grave mistake of dropping a perfectly good bone and jumping into the pool for a reflection that appears as good or better, only to find we have lost both. The number of new insect and fungous pests has multiplied rapidly in the past twenty years, and species of trees heretofore nearly immune to the attacks of many pests have begun to show susceptibility to newly introduced insects or fungi. The history of the chestnut tree of the eastern United States serves as a startling example of the wiping out of a desirable tree through the ravages of a disease imported from the Orient. Western white pine is too valuable a species to be sacrificed to the problematical increase in future values of the remaining species in the type. If the secondary species show promise of becoming valuable enough to manage as a timber crop in future years, how much more valuable white pine may become in the same period of time. We must accept the continued superiority of western white pine over the other species in the northern Idaho forests, and with this as a basis construct and put into effect a workable program of blister rust control for the protection of this tree. The argument that we have a plentiful supply of other species in this and other regions is not good forestry. We must strive to keep every acre of good forest soil producing trees of merchantable value. This can largely be brought about by improved forestry practices among which cutting to a diameter limit with its resultant residual stand commends itself for trial.

SIGNIFICANCE OF AN OBSERVED RANGE

By W. A. SHEWHART
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The Problem

HAVING taken a set of data we customarily are interested in at least two characteristics of the given group of observations, that is, some measure of the central tendency and some measure of the dispersion. From these two measures we try to form some estimate of the probability that a future average taken under supposedly the same conditions will fall within a given range and the probability that a single observation will fall within a given range. The most efficient way of determining such probabilities in the customary case is considered in a previous paper published in this Journal.[1] That paper presented new material showing that the mean probability associated with a given range is less than the probability associated with the mean range and gave for the first time at least an approximate method of estimating the mean probability associated with a given range, which probability is almost always required in practical problems.

If we have all of the observed values and have the time to calculate the standard deviation in the most efficient way, naturally we make use of information such as that given in the previous paper. Sometimes, however, we find that the results of a set of measurements or observations are reported in the form of the arithmetic mean of n observations together with the maximum and minimum observed values. Several instances of this kind have come to my attention in recent studies of published data giving the physical properties of timbers. Similar cases have been observed in many fields. In such cases, it becomes necessary to make some estimate of the probability associated with the observed range between the maximum and minimum values in a sample of size n and some estimate of the probable error of either a single observation or of an average. In this case we are forced to make use of the average, maximum, and minimum values in doing this.

Another case where engineers as well as scientists are often called upon to make similar estimates of probabilities arises when they are faced with several series of raw data not previously analyzed, except possibly for the determination of the averages. Cases of this character arise around a conference table, out in the field or in the shop, or, in general, on the job. Tentative estimates of these probabilities are required and some quick and ready method must be used.

It is the object of the present paper to provide a chart which will give estimates of the probabilities required in such cases. An example of the use of the chart will be given first and then this will be followed by a discussion of the theory and experimental results underlying the proposed use of the chart. *It will be seen that the new experimental results presented here give for the first time a means of estimating the mean probability associated with an observed*

[1] Shewhart, W. A. Note on the Probability Associated with the Error of a Single Observation. Journal of Forestry, May, 1928.

range. Possibly it should again be emphasized that the present method is only to be used where the one referred to above cannot be used, because of some practical or economic reason.

We shall confine our attention in this note simply to the use of the proposed method for interpreting results published only in the form of the arithmetic mean of n observations together with the maximum and minimum observed values. Examples of this kind are Tables 4 and 12 in the first edition of the very interesting book, "Timber, Its Strength, Seasoning and Grading," by Harold S. Betts.[1]

A typical set of data of this character obtained from another source is presented in Table 1. Naturally the engineer interested in the strengths of poles of Species A, B, and C wants to gain from the tabulated data some indication of the range of variation to be expected in future samples of poles from these species. Should he assume, for example, that the probability of a pole of Species A having a modulus of rupture within the range 2980 to 5690 is the same as that for a pole of Species B within the range 4460 to 7090, and so forth? Specifically, the two general questions answered by this paper are:

TABLE 1

Species of pole	Number of poles in sample	Modulus of rupture in lbs. per sq. in.		
		Average	Max.	Min.
A	4	3985	5690	2980
B	16	5978	7090	4460
C	100	5787	7790	3490

1. What is the probability associated with the range between maximum and minimum observed values in a sample of size n?

2. How can we obtain an estimate of the probable error of a single observation or of the average when only the mean, maximum, and minimum values of a set of n observations are given?

An Example

To illustrate the proposed method of answering these two questions we shall consider the data of Table 1. From curve I of Figure 1 we read directly the probabilities associated with the observed ranges for samples of 4, 16, and 100. These are given in the fourth column of Table 2.

To obtain an estimate of the probable error we require an estimate σ of the standard deviation σ' of the universe of poles of this species. Now, an estimate σ can be obtained with the aid of curve II of Figure 1 in the following way:

$$\sigma = \frac{\text{Observed range between maximum and minimum values}}{\text{Ordinate of curve II of Figure 1 for a sample of size } n},$$

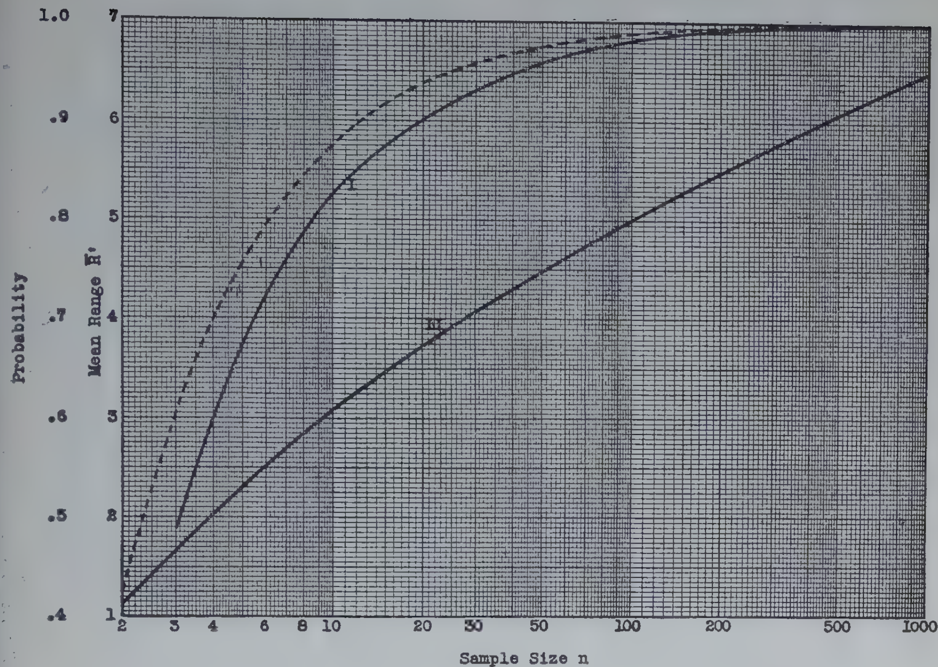
as is numerically illustrated in the fifth column of Table 2.

Theoretical Considerations

Stating the problem in general terms, let us assume that we have a set of n observed values of some chance variable X, which we may represent by X_1, X_2, . . . X_n. To be perfectly definite we may think of these measurements as being observations of modulus of rupture on n telephone poles. We may assume quite properly that this sample of n poles is drawn from a universe which we may characterize by the equation

$$dy = f(X)\,dX, \qquad (1)$$

[1] Published by McGraw-Hill Book Company, 1919, pp. 34 and 91.



———— I. Mean Probability Associated with Observed Range.
- - - - - - II. Probability Associated with Mean Range $\bar{R}'$.

FIG. 1. Probability and range chart.

TABLE 2

Species of pole	Number of poles in sample (n)	Observed range max.-min.	Estimate of probability of another pole of this species falling within observed range	Estimate of standard deviation (σ)	Estimate of probable error of single observation ($.6745\sigma$)	Estimate of probable error of average $\left(.6745 \frac{\sigma}{\sqrt{n}}\right)$
A	4	2710	.60	$\frac{2710}{2.06} = 1316$	888	444
B	16	2630	.88	$\frac{2630}{3.53} = 745$	503	126
C	100	4300	.98	$\frac{4300}{5.02} = 857$	578	58

dy representing the probability of a pole having a value of modulus of rupture X within the range X to $X+dX$. Now, if σ' be the root mean square deviation of the universe, it can be shown that the expected range $\bar{R}'$ between maximum and mimimum observed values in a sample of size n can be expressed as a function of σ' for the given universe. The functional relationship between $\bar{R}'$ and σ' of course depends upon the functional relationship $f(X)$ in equation 1. We shall limit the discussion of the present paper to a consideration of the significance of the observed range for the case where the function $f(X)$ in equation 1 is normal, or, in other words, where

$$f(X)=\frac{1}{\sigma'\sqrt{2\pi}}e^{-\frac{(X-\bar{X}')^2}{2\sigma'^2}}, \qquad (2)$$

$\bar{X}'$ being the mean or expected value of the universe. We shall then discuss briefly the possible effect of the failure of the physical conditions to meet this assumption.

Estimate σ of Standard Deviation σ' of Universe

Tippet[1] has recently tabulated the mean or expected range $\bar{R}'$ as a function of the size of the sample, $\bar{R}'$ being measured in terms of σ'. A form of these results is presented graphically (curve II) in Figure 1. The way in which this curve may be used is illustrated by application to the data for Species A of Table 1. For this case the observed range is $R=5690-2980=2710$. From this range we may determine an estimate σ of the true standard deviation σ' of the universe. For example, curve II of Figure 1 shows that for $n=4$ the expected range $\bar{R}_4'$ is $2.059\sigma'$. Hence we may obtain an estimate σ of the true standard deviation σ' from the relation

$$=\sigma\frac{R}{2.059}=\frac{2710}{2.059}=1316.$$

We have at once, therefore, the estimate of the probable error of a single observation $.6745\sigma$ and an estimate of the probable error of the arithmetic mean $\frac{.6745\sigma}{\sqrt{n}}$, these errors being interpretable in the customary way. In fact, the observed average $\bar{X}$ and the observed standard deviation σ may be substituted in equation 2 and the tabulated integral of this normal law function may be used to find approximately the probability associated with any range.

Estimate of Probability Associated With Observed Range

As a first approximation of the probability associated with an observed range we may take the probability associated with the expected range for a given sample size as determined for the normal law as shown in Figure 1. A specific example for the case $n=4$ will illustrate the method. Curve II of Figure 1 shows that the expected range is $2.059\sigma'$. We may, therefore, take twice the integral of the normal law over the range of 0 to 1.029 as an approximation for the probability sought. For the case $n=4$ this probability is .697. In this way probabilities associated with the different expected ranges have been caluclated and are presented graphically in the dotted curve of Figure 1. Thus this dotted

[1] Tippett, L. H. C. Range Between Extreme Individuals. Biometrika, Vol. XVII, Parts III and IV, December, 1925, pp. 364-387.

curve of Figure 1 may be used to read off directly first approximations for the probabilities associated with observed ranges for samples of size n. We see at once that for $n=4$, 16, and 100 used in Table 1, the associated probabilities are .697, .923, and .988. Enough has been said to show definitely that the probability associated with a given observed range is a function of the sample size.

However, the statistically trained analyst will be quite seriously disturbed by the assumptions which have been made in attaining the first approximation indicated in Figure 1, because it is obvious that the expected probability associated with the observed range for a sample of given size drawn from a normal population is less than the probability associated with the expected range as given in Figure 1, although it can be shown that this difference is a decreasing function of the sample size. Hence to form some estimate of the correction to be applied in practical cases to the dotted probability curve in Figure 1 the following experiment was made.

One thousand samples[1] of size 4 were drawn from a normal universe and the range between maximum and minimum observations for each sample determined. By means of the normal law integral table the percentages in the universe confined between the limits established by each of the thousand ranges were then obtained. The frequency distribution of these one thousand observed values of percentage (or we may say probability) are presented in Figure 2. The average of the thousand observed values of probability gives a quite accurate estimate of the expected probability associated with the range for samples of size 4 drawn from a normal universe. The average probability was, in this case, .599 or roughly a difference of .10 from the probability .697 associated with the expected range $2.059\sigma'$ for a sample of size $n=4$[2]. It will be observed that the probabilities associated with five of the thousand observed ranges were .06 and the probabilities of 27 of the thousand observed ranges were .98, whereas the average was .599. Thus about .5 per cent of the time, when we would have expected a probability of .599 associated with the observed range for $n=4$, we actually observed a probability as low as .06 and similarly about 2.7 per cent of the time when we would have expected a probability of .599 we actually observed a probability of approximately .98. Of course this dispersion of the distribution of probability associated with a given range decreases with sample size n.

In a similar way points were determined for 160 samples of $n=25$, 80 samples of $n=50$, 53 samples of $n=75$, 40 samples of $n=100$, and 4 samples of $n=1000$. Curve I of Figure 1 was then drawn through these points and hence the ordinate of this curve gives us an empirically determined estimate of the probability associated with the range between maximum $X_{\text{max.}}$ and minimum

[1] I am indebted to Miss M. B. Cater and Miss M. S. Harold for making this experiment and carrying out the calculations.

[2] It is approximately 99 per cent certain that the correction factor lies within the range $.10 \pm .01$.

$X_{min.}$ for samples for size n up to $n = 1000$.

Thus, in the general case, given a sample of any size n, we can read from curve I of Figure 1 an approximate estimate of the probability associated with the observed range $X_{max.} - X_{min.}$. As already indicated, there are more efficient Further discussion in this paper of the details of the methods of doing this are not entered into because they are of interest to the analyst of the data preparing the results for publication and cannot be applied by the reader to data presented in the form of Table 1 because the separate observations are not given.

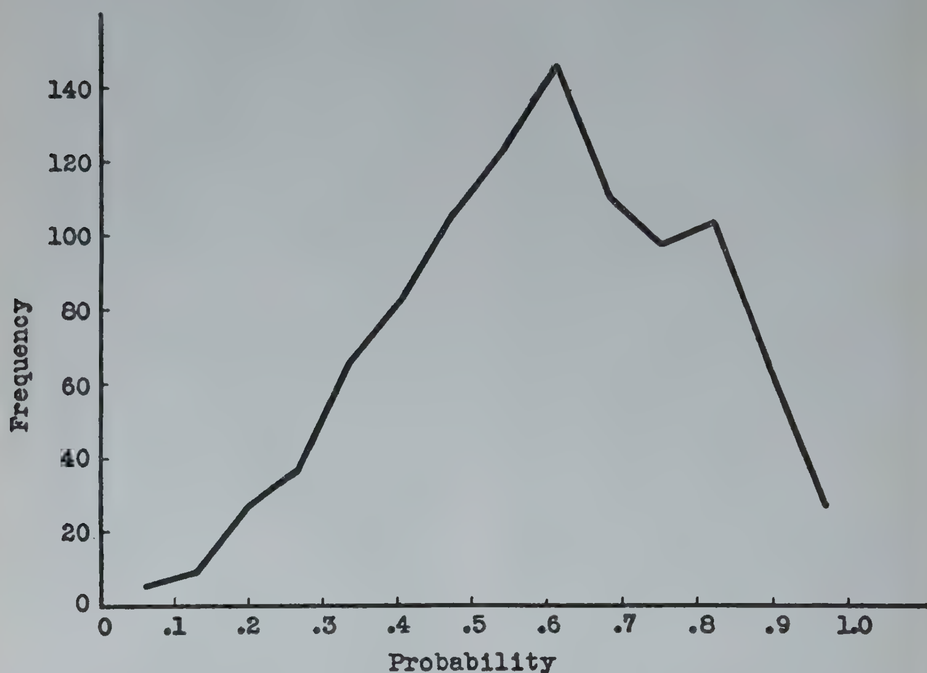


FIG. 2. Observed probabilities associated with ranges between maximum and minimum in samples of four drawn from a normal universe.

ways of determining this probability, namely by making the most efficient estimates of the expected value or average of the universe and of the standard deviation σ' of the universe and then using the normal law integral table to determine the probability associated with the range, certain corrections being made, as already noted, to take account of the reasoning *a posteriori.*

SUMMARY

It is, of course, highly desirable that the analyst of the data publish the most efficient estimates of the probabilities associated with the given ranges. *Where this has not been done, as in the cited cases, the method of the present paper makes possible a more efficient use of the published data than could otherwise be made.* Results of the character already referred to certainly show the necessity

of making due allowance for the size of the sample in the interpretation of data. Enough has been said to show, for example, that it would indeed be a serious mistake for the engineer using the data of Table 1 to assume, as is sometimes done, that the probabilities associated with these three ranges are approximately equal. Work has also been done to indicate that the probability curve of Figure 1 may be used without serious trouble even when there is reason to believe that the universe from which the sample is drawn differs but little from normal.

SEEDLINGS VERSUS TRANSPLANTS ON THE MICHIGAN SAND PLAINS

By R. G. SCHRECK
Forest Supervisor, Huron National Forest

THE Huron National Forest, due to natural conditions, presents a most interesting problem as a tree planting project. This Forest is located in what is often referred to as the "sand plains" region. The soil is a loose sand of glacial lake wash. It has little moisture-retaining power, and unless rains are experienced at very frequent intervals throughout the growing season, the grass and weed growth common to the region dries up and dies. Repeated fires have overrun this area and destroyed the timber growth to such an extent that the ground is almost completely occupied by grass and weed vegetation. The sodding over of the forest floor has retarded natural reproduction. For the same reason, planting without plowing or other ground preparation results in heavy losses.

There is considerable natural tree growth in ragged areas here and there which consists of a very inferior quality of jack pine and scrub oak. Because of the open and scrubby growth of these species comparatively little merchantable material is produced. There are scattered Norway pine trees present ranging in age from 50 to 130 years, and their thrifty condition proves that commercial stands of Norway pine can be produced.

The absence of rock, dense brush, and wind-thrown timber makes it possible to plow furrows and thus to plant trees easily and quickly and to obtain very satisfactory survivals. The trees are planted in the bottom of the furrows, which are eight feet apart. This plowing removes the weed and grass competition, conserves moisture, and provides an ideal situation for the planted trees to grow and develop.

Tree planting operations began on the Forest in 1910 and have grown from an annual program of a few acres to one of 5,000 acres. The combination of plowed furrows and the proper use of the Michigan planting bar is responsible in large measure for the success of the planting operations. When the planting bar is correctly used according to the system developed locally, lost motion is reduced to a mimimum and trees are planted as nearly automatically as is humanly possible.

During 1917 an experiment was initiated on the Forest to determine by means of planting 1-0, 2-0, 1-1, and 2-1 Norway pine stock, both in spring and fall, the most desirable age-class of nursery stock to use in field planting. Previous to this, two-year seedlings and transplants had been used with favorable results. However, looking ahead to large-scale planting operations, it was felt that the situation should be given careful thought and study by comparison to determine the least expensive class of stock which could be used to secure a well distributed stand.

An area was selected for this experiment on practically level ground, fairly representative of conditions found generally on the Forest. The scattered jack pine and scrub oak was removed from the experimental area so that uniform

conditions could be secured throughout. Twenty-four plots 80 feet square were laid out and monumented. Trees were planted four feet apart using the Michigan planting bar method in plowed furrows. Thus, each plot contained 400 trees. Planting began in the fall of 1917 and the spring of 1918 with 1-0 seedlings. During the years 1918-1922, spring and fall planting was carried on with the various classes of trees. The above tabulation explains the manner in which planting progressed.

CLASSES OF STOCK PLANTED

1917	1918		1919		1920		1921		1922
Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
1-0	1-0	2-0	2-0	2-1	2-1	2-1	2-1	2-1	2-1
		1-1	1-1	1-1	1-1	2-0	2-0		
		1-0	1-0	2-0	2-0	1-1	1-1		
				1-0	1-0	1-0			
						2-0			

It can be seen from the tabular arrangement that three full sets of trees for each age class were planted in both spring and fall, thus giving triple checks in every case. This was thought advisable in order to average weather conditions over a term of years for each class of stock. In addition to the above, a row of 1-0 stock and another of 2-0 stock containing 939 and 904 trees respectively were planted in the fall of 1920 as a further check on these two age classes.

Average weather conditions prevailed during the first five years of this experiment.

Counts and height measurements were made on each planting at the close of its fifth year in the field. The cost of the surviving trees in each class was also determined at this time by dividing the average cost of the nursery stock per thousand plus the average cost of planting per thousand by the per cent of survival.

This figure for each class was determined as far as possible from operating costs on the Huron National Forest. An average cost of planting of $3.01 per thousand was used for all classes of stock, since the variation in cost among the several classes was too small to consider. The average cost of the nursery stock follows:

Class of stock	Cost per M.
1-0 seedlings	$1.90
2-0 seedlings	2.41
1-1 transplants	3.91
2-1 transplants	4.43

Data collected at the end of the fifth year are summarized as follows:

Class of stock	Number of plots	Survival, per cent	Height, inches	Final cost per M.
1-0	7	70.0	14.6	$7.01
2-0	7	84.9	20.0	6.38
1-1	6	89.5	21.3	7.73
2-1	6	99.2	27.0	7.50

From these figures it is seen that the transplants show a higher survival than the seedlings, which was fully expected. Although the transplants show their superiority in survival, the 2-0 stock on the basis of survival, distribution, and height growth and the low final cost appears thus far to be the most economical class of stock to plant. The 1-0 stock, while making a fairly good showing thus far, is considerably below the 2-0 stock in survival and higher in final cost. As

a further check on one- and two-year seedling stock, additional experimental areas were planted in the spring and fall of 1926. Extremely dry weather prevailed immediately following the planting and the survivals were low, but the 2-0 seedlings again made a more favorable showing throughout and had a survival of 54.7 per cent as compared with 30.8 per cent for the 1-0 seedlings. These figures do not enter into the averages tabulated above.

The conclusions reached are that without doubt the two-year seedlings, considering all factors involved, are the most efficient class of stock to use in large scale planting operations on the Michigan sand plains. Further, that 1-0 stock can be used with comparative safety if necessary, but until a much better grade of this class of seedling is produced, it is not recommended for extensive planting.

Observations and a final analysis of the data will be made after all plants have been in the field ten years.

EFFECT OF DENSITY ON SEEDLING DEVELOPMENT

By JAY HIGGINS

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SINCE the establishment of the Bessey nursery on the Nebraska National Forest, a constant effort has been made to produce the hardiest class of transplants for sandhill conditions. Direct seeding, the planting of forest-pulled seedlings, and the planting of one and two-year-old nursery-grown seedlings, all failed in the early attempts to afforest the Nebraska sandhills. When transplant stock was used, more encouraging results were secured.

An experiment, started in 1914 to determine the effect of different spacings on the development of transplants, showed that a spacing of 6 by 1½ inches in the transplant beds was the most satisfactory and economical, considering both survival and final cost of surviving trees in the field. That test took into consideration only the different spacing the trees had in the transplant rows and did not attempt to go into the question of the density of the trees while in the seed beds.

At the Bessey nursery the practice followed is to sow seed broadcast in beds 4 feet wide and of convenient length, with 18-inch paths between the beds. The soil is quite sandy and does not have sufficient fertility to permit of growing trees in dense stands without seriously affecting the quality of the seedlings. In cases of thickly grown seedlings of 150 to 200 per square foot, it has been observed that the trees are taller and more spindling, also that the loss in the transplant beds is much heavier, than in the case of seedlings grown in less dense stands. To overcome the disadvantages of crowded seedlings, the tendency has been to reduce the density to 50 or 75 per square foot. This has greatly increased the area needed to produce the required number of trees and apparently has increased costs proportionately. With this element of uncertainity, the need for a systematic test to determine the optimum density for growing seedlings in the nursery became evident.

Accordingly, in 1921, an experiment was started in the nursery to determine: (1) The effect of different densities upon the size and development of the seedlings; (2) The effect upon survivals in the transplant beds and in the field two years after planting; and (3) The comparative cost per thousand of trees surviving at the end of the second year after planting. The experiment was conducted with both western yellow pine (*Pinus ponderosa*) and jack pine (*Pinus banksiana*) seedlings and was repeated in 1922 and 1923, thus making available results of three consecutive yearly tests.

Four density classes of 75, 100, 125, and 150 seedlings per square foot were used. Sufficient seed was sown on plots of 16 square feet each to produce the desired stands. Hand thinning was done to eliminate any excess trees and to secure as uniform distribution as possible. All beds were given the regular nursery care in weeding, watering, etc. After two years in the seed beds the several

classes were dug and carefully counted. All undersized and underdeveloped seedlings, which in the usual nursery practice would be culled out, were discarded and their number recorded. One hundred representative seedlings of each class were counted out, the dirt was shaken from the roots, and their weight was obtained immediately for comparative evidence regarding the development and size as affected by density.

One thousand trees of each lot were then transplanted. This was done according to the ordinary nursery practice. After one year in the transplant beds the trees were dug and carefully counted for survival. Five hundred of each lot were planted on typical field sites. The field planting was done according to the "slit-in-the-furrow" method by a selected crew. To eliminate any possible differences in sites, the several lots of trees were planted in a series of successive rows. Each planter changed the class of trees he was planting after completing his portion of each row. Survival counts were made after two years in the field. The summarized results of the three years' tests are given in Tables 1 and 2.

The figures given in these tables show differences due primarily to the density factor. The 150 density class of the jack pine test for 1922 was abandoned due to the loss of a good portion of the seedlings in the second year from the so-called "yellowing," a condition which has of recent years been developing in second year seed beds and is now believed to be the result of starvation for nitrogen in the soil.

In the 1922 yellow pine sowing, the 125 density group, Table 2, shows a final cost of $7.28, while the cost of the 150 density group is $6.11. This apparent inconsistency is due to the lower field survival in the 125 density group, caused at least in part by pocket gophers.

Also it will be noted that in Table 1 the weights of the 1922 jack pine seedlings are heavier for the greater densities. These figures should be disregarded as the record shows that sufficient care was not exercised in removing dirt from the roots and in drying excess moisture.

The final cost per thousand of the several lots of trees as shown in Table 2 has been computed by the following formula:

$$\text{Cost} = \cfrac{\cfrac{\cfrac{(S+SC+SC_2)\ 1.0p}{\cfrac{A\times N}{1000}} + TC + SC_3}{SN} + PC}{SF}$$

in which:

S = Cost of seed for a 4 by 4 foot bed.
SC = Cost of preparation, care, and watering of first year seedlings per bed, based on average cost per square foot for entire nursery.
SC_2 = Cost of care and watering for second year obtained in same manner as SC.
p = Percentage discarded in grading prior to transplanting.
A = Area in bed.
N = Number of seedlings per square foot.
TC = Cost per M of transplanting, average nursery figure.
SC_3 = Cost of care in transplant beds, average nursery figure.
PC = Cost of planting, average figure.
SN = Percentage of survival at end of year in transplant beds.
SF = Percentage of field survival.

The above formula allows for the variable factor, cost of care, which is uniform per square foot but variable per thousand

Species	Year of sowing	Density class 75			Density class 100			Density class 125			Density class 150		
		Actual density per sq. ft.	Culled seedlings	Average weight per seedling	Actual density per sq. ft.	Culled seedlings	Average weight per seedling	Actual density per sq. ft.	Culled seedlings	Average weight per seedling	Actual density per sq. ft.	Culled seedlings	Average weight per seedling
		Number	*Per cent*	*Grams*	*Number*	*Per cent*	*Grams*	*Number*	*Per cent*	*Grams*	*Number*	*Per cent*	*Grams*
Western yellow pine	1921	71.0	4.0	6.04	79.0	8.0	6.01	111	7.8	4.53	127	9.0	4.51
	1922	80.5	7.5	4.40	108.3	12.9	3.93	125	14.5	2.66	154.6	18.0	2.56
	1923	76.0	4.7	1.50	97.0	1.7	1.72	126	6.1	1.47	142	6.2	0.747
	Ave.	75.8	5.4	3.98	94.8	7.5	3.88	120.7	9.4	2.88	141.2	11.07	2.6
Jack pine	1921	74.50	22.2	4.90	98.0	19.0	4.10	123.0	22.1	4.70	155	24.1	3.4
	1922	76.75	23.0	1.94	87.75	36.2	2.61	100.7	25.0	2.50	Aband	oned	
	1923	53.00	6.7	2.40	85.25	4.8	1.37	99.5	6.1	1.36	145	6.4	1.6
	Ave.	68.00	17.3	3.08	90.3	20.0	2.69	107.7	17.7	2.85	150	15.2	2.5

TABLE 2

SURVIVAL AFTER SECOND YEAR IN THE FIELD AND COMPARATIVE COST BY DENSITY GROUPS

Species	Year of sowing	Density class 75			Density class 100			Density class 125			Density class 150		
		Survival in transplant beds	Survival after second year in field	Final cost per M	Survival in transplant beds	Survival after second year in field	Final cost per M	Survival in transplant beds	Survival after second year in field	Final cost per M	Survival in transplant beds	Survival after second year in field	Final cost per M
		Per cent	*Per cent*		*Per cent*	*Per cent*		*Per cent*	*Per cent*		*Per cent*	*Per cent*	
Western yellow pine	1921	92.5	80.0	$4.18	95.8	77.0	$4.35	98.2	72.4	$4.36	95.0	76.8	$4.17
	1922	93.16	71.0	4.59	84.0	64.0	5.21	82.33	46.6	7.28	80.83	55.0	6.11
	1923	82.5	74.4	4.68	83.3	60.4	5.58	83.7	67.2	4.92	81.1	51.0	6.58
	Ave.	89.3	75.1	4.48	87.7	67.1	5.05	88.07	62.1	5.52	85.64	60.9	5.62
Jack pine	1921	91.1	54.1	5.91	91.0	59.2	5.20	89.3	55.0	5.54	96.4	59.0	4.90
	1922	92.1	54.8	5.79	94.0	46.8	6.78	91.5	47.4	6.60	Aband	oned	
	1923	75.6	77.5	4.75	68.3	59.2	5.99	70.3	74.0	4.67	73.6	49.7	6.47
	Ave.	86.2	62.1	5.48	84.4	55.07	5.99	83.7	58.8	5.60	85.0	54.3	5.68

because of different densities. The formula was applied at the close of the second year in the field, as further losses after that time would undoubtedly be due as much to other factors as to density in the seed beds.

In arriving at the final cost per thousand, the fiugres given are relative rather than absolute, since only direct costs have been included and indirect costs, which are ordinarily apportioned in the nursery and planting operations, have not been added.

The following conclusions can be drawn from this study:

1. The best classes of two year western yellow and jack pine seedlings were raised at densities of about 75 to the square foot. With the increase in the density to 150 to the square foot, there was a decrease in the weight of the seedlings and an increase in the percentage of culls.

2. The better developed seedlings of the plots of lowest density maintained their advantage in the transplant beds and in the first two years in the field plantations. The survivals in transplant beds and field decrease with each increasing density class.

3. The final cost per thousand of the surviving trees at the end of the second year in the field is lowest for the trees of lowest seed-bed density and increases uniformly with each increasing density class.

4. The results of this experiment are in line with the approved practice at the Bessey nursery. For conditions in the Nebraska sandhills, seedlings must have plenty of room for development, and they should ordinarily not have a greater density than 100 to the square foot. The effect of crowding is more marked for western yellow than for jack pine.

STUDIES OF THE BOARD FOOT, CUBIC FOOT, AND CORD UNITS OF WOOD MEASUREMENT

BY THE ASSOCIATION OF FOREST ENGINEERS FOR THE PROVINCE OF QUEBEC

THE Association of Forest Engineers for the Province of Quebec has, for the last three or four years, been occupied with study of the relative values of these units for measurement of sawlogs and pulpwood and of the relation between the three units when applied to the same wood. This work was done in cooperation with, and with the very active assistance of, the Quebec Forest Service, the Dominion Forest Service, the Donnacona Paper Company, the Brown Corporation, Price Brothers & Company, and the Hammermill Paper Company; other companies and organizations assisted with data.

The work on the board foot unit was confined to the Quebec Log Rule and to this extent is of less general interest than the work on the cubic foot and cord units. A summary of the work done is presented here, in two parts: first, the board foot and cubic foot units; second, the board foot, cubic foot, and cord units.

Part 1. Board Foot and Cubic Foot Units

The Quebec Forest Service has made an extensive study of the value of the Quebec Log Rule as a true expression of the content of logs in board feet, and we have been supplied with the results of this very valuable piece of work.

Table 1 shows the general results obtained from this work for logs of 12, 13, 14, 15, and 16 feet in length. Overrun in logs would seem to depend mainly on small end diameter of log, on length of log, and on taper, in addition to the efficiency to the sawmill. Small end diameter of log and taper are functions of certain conditions in the tree from which the log is cut:

1. Form class or form factor.
2. Diameter at breast height.
3. Height.

Small end diameter and taper would depend also on operating conditions, stump height, used top diameter, stump diameter limit, and log length.

It would be possible to make an examination of these various factors, or of some of them, as they affect the overrun of logs of different small end diameters. A complete examination of this, however, would involve following individual logs from the tree to the sorting table in the sawmill.

An examination of the effect of these factors on cubic foot content of logs of different small end diameters is simpler, since cubic foot content of logs can be measured as trees are felled. The data presented are derived from field measurements by the Dominion Forest Service in cooperation with the following companies operating in Quebec Province:

Donnacona Paper Company on the River Sautauriski.

Brown Corporation on the River Pappanachois.

Price Brothers & Company on the River Shipshaw.

Hammermill Paper Company at Matane.

TABLE 1

COMPARISON OF CONTENTS OF LOGS OF DIFFERENT SIZES AS DETERMINED BY MILL PRODUCTION AND BY THE QUEBEC LOG RULE, 1924-1925. DATA CURVED

Small end diameter	Length of log in feet									
	12		13		14		15		16	
	Mill production	Quebec log rule	Mill production	Quebec log rule	Mill production	Quebec log rule	Mill production	Quebec log rule	Mill production	Quebec log rule
Inches	*Board feet*									
5	8.5	8	10	9	12	10	13	11	12	12
6	15	12	16.5	13	18	14	30	15	22	16
7	22	18	24	19	26	21	28	22	30	24
8	30	24	32	26	34	28	36	30	38	32
9	39	34	41	37	43	49	45	42	47.5	45
10	49	44	52	48	54	51	56	55	59	59
11	60	50	63	54	66	58	69	62	73	67
12	73	60	77	65	80	70	84	75	88	80
13	87	75	91	81	95	87	99	94	104	100
14	104	90	109	97	113	105	118	112	123	120
15	124	100	129	108	134	117	134	125	144	133
16	145	120	150	130	156	140	161	150	167	160

The following are percentage stand tables for the four localities in which the measurements were made:

Diameter at breast height outside bark	Locality			
	Shipshaw	Sautauriski	Papanachois	Matane
Inches	*Per cent*			
4	....	....	....	.3
5	6.0	1.9	16.6	3.9
6	18.6	21.4	27.2	9.6
7	19.4	24.8	25.6	18.8
8	20.2	21.0	11.4	13.9
9	11.7	13.8	4.3	15.7
10	11.7	11.9	6.7	9.4
11	5.3	3.8	2.7	6.5
12	5.3	.9	2.7	9.4
13	.9	....	.4	6.2
14	.9	.5	1.6	2.3
15	....	....	.4	2.6
16	....	....	.4	.8
17	....	....	....	.3
18	....	....	....	.3
	100.0	100.0	100.0	100.0

The cubic foot unit gives a true expression of wood content if measured correctly, but there are practical difficulties in the way of its correct application, though these difficulties may not be, necessarily, insurmountable. Two methods of measurement are practicable under present woods conditions:

1. Measure both ends, and apply Smalian's formula.

2. Measure small end and apply a cubic foot rule based on small end diameter, in the same way that the Quebec Log Rule is based on small end diameter.

Measurements of Both Ends of Log.

If logs were consistently in the form of a truncated paraboloid, this method would give sufficiently accurate results, but very serious error may arise if the average form deviates from this. We have summarized the figures available

with a view to showing the effect of this source of error on logs and on the total quantity of wood cut in a given stand of timber. Table 2 gives figures for logs for two localities, and Table 3 gives figures for the whole tree for the three localities in which stump height measurements were taken.

The following may be noted:

1. The effect of stump height is very apparent in Table 3, as between trees cut to a stump height of ½ foot and those cut to a stump height of 1½ feet.

2. In spite of Matane measurements being on larger timber, the percentage error is no greater than that for the other localities.

3. In Table 2, the error is more pronounced in butt logs, and this error tends to increase with size of log.

To summarize:

1. The measurement of large and small end diameter as a basis for calculating cubic foot content of logs may cause serious errors, as high as about 7 per cent in the cases examined. These figures are for pulpwood stands of small trees averaging 7 to 10 inches in breast high diameter outside of bark.

2. The error from this source is not constant and may vary with different factors.

(a) Stump height—with higher stumps the error may, in general, be expected to decrease.

(b) Average height—it seems probable that if the average height of the trees increases, the error in the butt logs will tend to be neutralized to a greater extent and the total error reduced.

Other factors may enter and no final conclusion can be drawn in respect to these errors until similar measurements have been made on larger timber and on logs of other lengths than 12 feet.

Measurement of Small End of Log Only.

It is clear that cubic foot content for a log of given small end diameter will vary with taper (that is, the difference between the two end diameters) and with shape of log between the two ends.

The figures in Table 2 are differences between cubic foot content based on small and large end diameter (representing the cubic foot content of a truncated paraboloid) and approximately accurate cubic content based on diameter measurements at four-foot intervals. The variation from the cubic content of a truncated paraboloid, shown in Table 2, must be due to shape of log. It will be seen, from the material examined, that shape causes variation up to 12 or 15 per cent in cubic content. The truncated paraboloid does not represent the true cubic content of the log, the error being greatest in butt logs, only up to 2 per cent in other logs in other parts of the tree, and for whole stands (Table 3) up to 7 per cent.

Cubic foot contents of logs measured in the four localities, calculated from measurement of diameter at 4-foot intervals, have been summarized for butt logs separated by stump height, for logs in the center section of the tree, and for logs in the top of the tree; these figures have been classified for each inch class of small end diameter. The effect of stump height on cubic foot content of log of given small end diameter is not apparent from the summary made, and covering table has not been included. Table 4 shows a comparison of the cubic foot content of

TABLE 2

DIFFERENCES IN CUBIC CONTENT OF 12-FOOT LOGS BETWEEN APPROXIMATELY ACCURATE FIGURES BASED ON DIAMETER MEASUREMENTS AT EACH 4 FEET OF LENGTH AND ERRONEOUS FIGURES BASED ON DIAMETER MEASUREMENTS AT TOP AND BOTTOM OF LOG

Small end diameter of log inside bark	Butt logs												Center logs				Top logs			
	Shipshaw						Sautauriski						Shipshaw		Sautauriski		Shipshaw		Sautauriski	
	Approximate stump height						Approximate stump height													
	½ foot		1 foot		1½ feet		½ foot		1 foot		1½ feet									
Inches	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
3	...	......	...	......	...	......	...	......	...	......	...	......	...	......	...	......	68	— 0.5	65	+ 0.6
4	7	+ 4.6	...	......	1	—13.0	6	+ 8.8	...	......	...	......	1	......	3	+ 7.0	121	+ 0.6	100	......
5	30	+ 4.4	15	+ 5.7	6	+ .5	42	+11.4	2	+ 6.0	1	+ 7.0	43	— 2.5	56	— 2.2	63	— 2.1	45	— 1.0
6	18	+ 4.1	25	+ 5.4	8	+ 4.1	48	+12.6	8	+ 7.9	1	+ 2.0	83	— 0.2	53	— 0.6	5	+ 0.2	6	+ 2.0
7	13	+ 5.5	29	+ 6.9	11	+ 7.8	44	+15.3	9	+13.3	2	+ 9.0	56	— 0.7	31	— 1.2	1	+ 2.0	...	......
8	10	+ 9.3	21	+ 6.5	8	+ 3.7	21	+14.5	6	+14.3	1	+ 1.0	32	— 0.2	10	+ 0.1	...	......	...	......
9	3	+14.3	15	+ 9.9	4	+11.7	13	+13.1	2	+ 7.0	...	......	25	— 0.1	2	+ 3.5	...	......	...	......
10	3	+12.0	9	+ 9.0	6	+11.0	2	+ 6.5	1	+17.0	1	+ 6.0	7	+ 1.0	1	— 6.0	...	......	...	......
11	1	+12.0	3	+ 8.7	2	+ 8.5	...	......	1	......	...	......	2	— 2.5	...	......	...	......	...	......
12	1	+ 7.0	...	......	...	......	...	......	1	+14.0	...	......	1	— 6.0	...	......	...	......	...	......

Columns headed "a" show number of logs measured. Columns headed "b" show percentage differences. + indicates that erroneous figures are greater; — indicates that they are less. Diameter classes are to nearest inch as actually measured. Volumes are based on diameter as measured in ordinary scaling practice, diameters below ¾ inch point falling into lower inch class.

TABLE 3

DIFFERENCES IN MERCHANTABLE CUBIC CONTENT OF TREES BETWEEN APPROXIMATELY ACCURATE FIGURES BASED ON DIAMETER MEASUREMENTS AT EACH 4 FEET OF LENGTH AND ERRONEOUS FIGURES BASED ON DIAMETER MEASUREMENTS AT TOP AND BOTTOM OF EACH 12-FOOT LOG

Diameter at breast height outside bark	Shipshaw						Sautauriski						Matane					
	Approximate stump height						Approximate stump height						Approximate stump height					
	½ foot		1 foot		1½ feet		½ foot		1 foot		1½ feet		½ foot		1 foot		1½ feet	
Inches	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
4	...	......	...	......	...	......	...	......	...	......	...	......	...	......	1	+ 1.0	...	......
5	13	+ 1.8	1	−14.0	1	+ 6.0	4	+ 6.5	...	......	...	......	9	+ 5.7	6	+ 6.0	...	......
6	25	+ 2.8	16	+ 2.3	5	− 1.0	43	+ 5.7	2	+16.0	...	......	15	+ 8.3	20	+ 6.7	1	+13.0
7	17	+ 1.4	24	+ 2.4	7	+ .7	46	+ 7.5	5	+ 6.0	1	+ 0.5	19	+ 6.8	47	+ 5.5	6	+ 8.2
8	10	+ 2.0	32	+ 2.6	8	+ 1.4	37	+ 8.3	5	+ 7.4	2	+ 4.0	18	+ 7.0	28	+ 7.6	7	+ 5.6
9	7	+ 3.6	11	+ 2.4	11	+ 1.9	26	+ 6.5	2	+11.5	1	......	10	+ 8.6	38	+ 5.9	12	+ 9.2
10	2	+ 2.5	24	+ 5.2	3	+ 3.3	21	+ 6.8	3	+ 5.0	1	+ 2.0	9	+ 8.0	18	+ 6.5	9	+ 8.1
11	2	+ 5.5	5	+ 5.2	6	+ 4.0	4	+ 5.2	3	+ 3.0	1	+ 7.0	5	+ 6.4	16	+ 6.0	4	+ 4.7
12	3	+ 5.3	7	+ 4.7	3	+ 6.0	1	+ 1.0	1	+ 1.0	...	......	3	+ 3.7	25	+ 8.2	8	+ 7.0
13	...	......	2	+ 7.0	...	......	...	......	...	......	...	......	5	+ 8.4	16	+ 7.9	3	+13.3
14	...	......	1	− 2.0	1	+ 3.0	...	......	1	+ 7.0	...	......	2	+13.5	3	+ 6.0	4	+ 9.2
15	...	......	...	......	...	......	...	......	...	......	...	......	3	+ 5.3	4	+ 9.7	3	+ 9.3
16	...	......	...	......	...	......	...	......	...	......	...	......	...	......	1	+ 5.0	2	+ 8.0
17	...	......	...	......	...	......	...	......	...	......	...	......	1	+ 7.0	...	......	...	......
18	...	......	...	......	...	......	...	......	...	......	...	......	...	......	1	+ 9.0	...	......
Totals and averages	79	+ 2.5	123	+ 3.1	45	+ 1.9	182	+ 6.9	22	+ 7.0	6	+ 2.9	99	+ 7.3	224	+ 6.6	59	+ 8.1

Columns headed "a" show number of trees measured. Columns headed "b" show percentage differences. + indicates that erroneous figures are greater; — indicated that they are less. Averages for all trees—Shipshaw 2.7%—Sautauriski 6.8%—Papanachois 6.2%—Matane 7.0%. Diameters of trees are to nearest inch as actually measured. Volumes are based on diameters as measured in ordinary scaling practice, diameters below ⅝ inch point falling into lower inch classes.

TABLE 4.

COMPARISON OF CUBIC CONTENTS OF 12-FOOT BUTT, CENTER, AND TOP LOGS BY LOCALITIES

Small end diameter of log inside bark	Shipshaw						Sautauriski						Papanachois						Matane					
	Butt		Center		Top		Butt		Center		Top		Butt		Center		Top		Butt		Center		Top	
Inches	a	b		b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b	a	b
3	...	....	...	....	68	1.12	...	....	...	....	66	1.07	7	0.97	...	....	89	0.99	...	....	...	....	76	1.21
4	8	1.27	1	1.30	123	1.43	5	1.54	4	1.32	100	1.40	62	1.30	3	1.56	93	1.41	18	1.58	2	1.16	140	1.58
5	52	1.89	42	1.99	63	2.08	45	2.09	56	2.00	40	2.13	82	1.94	15	1.86	17	2.12	42	2.03	27	2.19	124	2.23
6	51	2.66	87	2.77	5	2.78	57	2.95	55	2.79	...	....	45	2.68	21	2.97	9	3.03	69	2.90	94	2.89	21	2.97
7	54	3.63	52	3.68	1	3.20	55	3.91	28	3.56	...	....	18	3.81	20	3.87	1	3.20	75	3.84	78	3.78	3	4.02
8	40	4.77	31	4.46	...	....	25	5.07	11	4.66	...	....	14	4.86	11	4.60	1	4.90	53	5.04	63	4.80	2	6.13
9	21	5.96	21	5.62	...	....	17	6.23	2	6.00	...	....	12	6.30	6	5.66	...	....	33	6.35	46	5.99	1	6.29

Columns "a" show number of logs measured. Columns "b" show average cubic foot contents. Diameters of logs are to nearest inch, as actually measured. Volumes are based on diameters as measured in ordinary scaling practice, diameters below $\frac{8}{10}$ inch point falling into lower inch class.

butt, center, and top logs. In the smaller log diameter classes there is a distinct tendency for butt logs to show less cubic foot content than center or top logs of the same small end diameter; while in larger log diameter classes the tendency is for the butt logs to show higher cubic content than other logs of the same small end diameter.

Table 5 summarizes cubic foot content of all logs of given small end diameter for the four localities. It may be noted that the Matane figures, in the larger timber, show considerably larger cubic foot content in the smaller logs. In the three other localities differences in average size of timber are not so marked.

The general effect of these differences on total cubic foot content of all logs cut in a given locality has been examined. By applying Shipsaw figures for cubic content to the logs cut in the Sautauriski and Papanachois localities, errors of 4 per cent and 1 per cent in scale arise; by applying Matane figures for cubic content to logs cut on the Papanachois, there is an over scale of 5 per cent. These differences, while not negligible, are not very large; the differences in size of timber, however, are not very large either. It seems evident that under a wider range of conditions, greater variation of cubic foot content for a log of given small end diameter may occur.

Causes for variation in taper and shape of logs (and so in content for given length and small end diameter) are form class, diameter at breast height, total height, and operating conditions. For the purpose of illustrating the effect of these factors in a wider range of timber, general taper charts may be employed, such as illustrated in "New Devices for Solving Some Problems in Forest Mensuration," Journal of Forestry, 1923. From such charts, developed from taper tables as illustrated in article "Investigation of Taper," Journal of Forestry, 1923, cubic volumes of logs can be summarized. Table 6 shows average cubic foot content derived in this manner for 12-foot logs in representative pulpwood stands. It will be noted that these figures from general taper tables run close to the figures observed in the different localities, but do differ.

The various factors noted above will be discussed separately:

Form Class. It will be noted in Table 6 that cubic content for small logs is greater in form class 70 than in form class 65. In the higher form class the bole is carried higher, consequently taper is more rapid in the top of the tree and cubic content of the smaller logs in the top of the tree may be expected to be greater for given small end diameter. In larger logs in the lower part of the tree taper is less in the higher form class and consequently cubic content is less. However, for the general size of timber illustrated, the differences between total cubic content of logs cut from trees of form class 65 and cubic content of logs cut from trees of form class 70 is about 1 per cent. Form classes 65 and 70 cover the range of average form class in merchantable stands of pulpwood such as illustrated. Even in very large timber the average form class will not rise much above 70, so that there is some justification for the statement that the effect of form class on cubic content of logs of given small end diameter would not be of great importance in itself.

Height of Tree. In general the shorter the tree the greater the taper of log for a given form class and consequently the

TABLE 5

AVERAGE CUBIC CONTENT OF 12-FOOT LOGS, BASED ON DIAMETER MEASUREMENTS AT EACH 4 FEET OF LENGTH, BY LOCALITIES

Small end diameter of log inside bark	Shipshaw		Sautauriski		Papanachois		Matane	
Inches	a	b	a	b	a	b	a	b
3	68	1.12	66	1.07	96	0.99	76	1.21
4	132	1.42	109	1.40	158	1.37	160	1.57
5	157	1.99	141	2.07	114	1.96	193	2.19
6	143	2.73	112	2.87	75	2.80	184	2.91
7	107	3.66	83	3.79	39	3.81	156	3.82
8	71	4.63	36	4.94	26	4.75	118	4.92
9	42	5.79	19	6.20	18	6.09	80	6.14
10	25	7.47	5	7.78	12	7.61	55	7.63
11	8	8.78	1	9.40	5	10.24	42	8.86
12	2	9.40	1	11.20	1	9.70	23	10.30
13	1	12.50	...	.....	1	14.30	12	12.31
14	...	.....	...	.....	...	.....	5	13.80

Columns headed "a" show number of logs measured. Columns headed "b" show average cubic foot contents. Diameter of logs are to nearest inch, as actually measured. Volumes are based on diameters as measured in ordinary scaling practice, diameters below ¾ inch point falling into lower inch class.

TABLE 6

CUBIC CONTENT OF 12-FOOT LOGS DERIVED FROM VOLUME TABLES BASED ON GENERAL TAPER TABLES

Small end diameter of logs	Form class 65		Form class 70	
	Content of all trees 4″ DBH and up	Content of all trees 6″ DBH and up	Content of all trees 4″ DBH and up	Content of all trees 6″ DBH and up
Inches	*Cubic feet*	*Cubic feet*	*Cubic feet*	*Cubic feet*
3	.72	.97	.86	1.13
4	1.25	1.35	1.30	1.42
5	1.90	1.90	1.88	1.88
6	2.68	2.68	2.60	2.60
7	3.58	3.58	3.44	3.44
8	4.62	4.62	4.43	4.43
9	5.85	5.85	5.65	5.65
10	7.20	7.20	6.95	6.95
11	8.70	8.70	8.40	8.40

These figures are for the following stand table:

Diameter, inches	4	5	6	7	8	9	10	11	12
Number of trees.......	23	20	17	13	9	6	5	3	2

greater the cubic content for a log of given small end diameter; there is not the same compensating effect as in variation of form class noted above. For timber of the class illustrated in Table 6, the error obtained by applying cubic figures for tall trees to logs from trees 10 feet shorter is about 3 per cent. A proper check of this from field measurements would involve comparison of cubic content per log for stands of timber of varying average height, but otherwise sufficiently similar to prevent other factors neutralizing any possible effect of height.

Diameter at Breast Height. Table 7 shows average cubic content of logs derived from the same source as figures in Table 6, but calculated for large spruce such as is cut for sawlogs. By applying figures for log content shown in Table 7 to the log summary for pulpwood of the size exemplified in Table 6, there is an over scale of about 14 per cent. In general the higher in the tree the log of a given small end diameter is situated the greater the taper and the more the log tends to show greater volume than that of a truncated paraboloid of the same taper, so that the cubic content of a log of given small end diameter tends to be greater in larger trees. This is demonstrated very clearly by the figures in Table 8, which show the relation between cubic content of log and diameter at breast height of tree from which the log is cut. A comparison of this relation, based on general taper tables, with

TABLE 7

CUBIC CONTENT OF 12-FOOT LOGS DERIVED FROM VOLUME TABLES BASED ON GENERAL TAPER TABLES

Small end diameter of log *Inches*	Content of all trees 8″ DBH and up *Cubic feet*
3	1.00
4	1.60
5	2.28
6	3.06
7	3.96
8	5.00
9	6.19
10	7.55
11	9.0
12	10.7
13	12.5
14	14.6
15	16.8
16	19.2
17	21.7
18	24.3
19	27.0
20	29.9
21	33.2
22	37.0

These figures are for spruce form class 65 and for the following stand table:

Diameter, inches	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Number of trees	67	62	60	45	37	34	33	22	20	16	12	8	7	3	2	1	1

similar relation drawn from the material in the localities examined, shows that there is close correspondence between the figures from general taper tables and the observed figures. To summarize, there appears to be a very definite relation between cubic content of log and diameter at breast height of the tree from which the log was cut.

TABLE 8

RELATION OF CUBIC FOOT CONTENT OF 12-FOOT LOGS TO DIAMETER AT BREAST HEIGHT OF TREE FROM WHICH LOG IS CUT

From General Taper Tables, Spruce Form Class 65

	Small end diameter of log, inches							
Diameter of tree inches	3 Cubic foot content	4 Cubic foot content	5 Cubic foot content	6 Cubic foot content	7 Cubic foot content	8 Cubic foot content	9 Cubic foot content	10 Cubic foot content
4	.65							
5	.78	1.10						
6	....	1.20	1.70					
7	....	....	1.90	2.50				
8	.98	....	....	2.68	3.45			
9		1.52	....	....	3.65	4.43		
10		....	2.17	....	3.60	....	5.73	
11		....	....	3.15	....	4.90	....	7.10
12		1.82	....	....	4.27	....	6.23	7.20
13			2.50	....	....	5.35	....	7.20
14				3.44	....	4.80	....	....
15				3.70	....	....	6.15	....
16				....	4.53	....	....	7.85
17				....	....	5.70	....	....
18				....	....	....	7.10	....
19			3.16	....	....	....	7.20	....
20				4.35	....	....		8.90
21					5.50	....		
22					5.60	....		
23						6.65		
24						6.70		

Diameters of trees and small end diameters of logs are to nearest inch as actually measured. Cubic contents are based on diameters as measured in ordinary scaling practice, diameters below ¾ inch point falling into lower inch class.

Operating Conditions. In general, the lower the stump the greater may be expected to be the effect of root swelling on cubic volume, though, if this effect exists, it is not clearly apparent from any of the summaries made.

If the size of the top utilized is uniform in small and large trees in a given locality, this factor will not affect cubic content of logs of given small end diameter. However, since the top utilized is generally variable, it is clear, from Table 8, that the average cubic content of logs of a given small end diameter will be less, if this particular size of log is

cut in the smaller trees only, than it would be if logs of this size were cut in larger trees also. By applying figures from Table 8, to stand tables shown in Tables 6 and 7, it can readily be shown that the final effect of this on total logs cut in a given locality would in general not be of great importance.

The stump diameter limit affects the average size of the timber from which logs are cut, and so affects average cubic content of logs of given small end diameter. This factor is covered by the discussion on effect of size of timber.

It would seem that log length should not be a disturbing factor in the cubic content for a given small end diameter. However, we have not had an opportunity of going into this.

It seems, therefore, that operating conditions may have some effect on cubic content of log of given small end diameter, but, as far as our investigation has gone, perhaps no very important effect, other than is provided for in consideration of effect of size of timber.

Conclusion to Part One.

As indicated in the tables presented, small end diameters of logs are shown to the nearest inch while volumes are based on diameter classes separated at the $\frac{3}{4}$-inch point. This gives a lower than true cubic content for a log of given small end diameter, but makes the cubic content comparable with the board foot content of a log of the same small end diameter.

It seems that under present woods conditions, there are two ways of applying the cubic foot unit: measure both ends of log; or measure small end and apply a cubic foot log rule based on small end diameter.

The first method may involve an error in scale as high as 7 per cent in small timber. The error may vary with stump height, and probably with size and height of trees. No final conclusion can be drawn until further work is done, particularly in large timber.

In regard to the second method, it has been shown that logs of the same small end diameter do not have the same cubic content under different conditions, and that the variation may be so large as to cause important error in applying a general cubic foot rule. The general size of the timber seems to have the most important effect, causing variation up to 14 per cent or perhaps more, while form class and height of trees and certain operating conditions may also cause variation, though probably not to such a degree as size of timber.

The work has not progressed far enough to allow a comparison of values of the three units. In regard to the cubic foot unit, the work done has shown that there are certain factors which must be considered in applying the unit; it has not been shown that the cubic foot unit is incapable of application.

Part 2. Relation of Cord to Board Foot and Cubic Foot

The first question that arises is—"What is the understanding as to the definition of a cord?" The statutory dimensions are 8 feet by 4 feet by 4 feet, but the exact relation that these dimensions bear to stacks of cordwood is not fully defined. There are three main alternatives as to the definition of the cord:

1. The wood that can be piled into a space of 8 feet by 4 feet by 4 feet, in

such a way that no wood overlaps the limits of these dimensions.

2. The wood included in a space of 8 feet by 4 feet by 4 feet, within a pile 8 feet long but more than 4 feet high.

3. The wood included in a space of 8 feet by 4 feet by 4 feet, within a pile more than 8 feet long and more than 4 feet high.

It is clear that, other things being equal, the cord contains more wood in the third than in the second case, and that the cord contains more wood in the second than in the first case.

There is variation in the amount of solid wood contained in the cord, in accordance with the following factors:

1. The definition of the cord as above noted.

2. Length, diameter, and taper of the wood.

3. Straightness or smoothness of wood, proportion of bark to solid wood, height of stump, causing varying basal flare in butt logs, and proportion of rot or other defect.

4. Method of piling the wood.

For wood about 4 feet long, the influence of length of bolt on cubic content of the cord is not very great; for example, 2-foot wood gives about 2 per cent more solid content than 4-foot wood, and 6-foot wood about 3 per cent less (Chapman, Forest Mensuration, Chapter 9, Table 21). Therefore the effect of any slight difference in length (such as the difference between 4-foot wood and wood 4 feet 2 inches long) may be neglected.

Peeled wood gives, of course, considerably higher content than rough wood, and a variation in bark thickness may have an appreciable effect on solid content. The average taper of 4-foot wood may vary from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch; the effect of difference of taper within this range on closeness of piling and so on solid content is very small. The effects on solid content of butt swelling, straightness or roughness of bolts, or method of piling are important but can hardly be related to any standard that can be used under practical woods conditions. No consideration can be given to the influence of defect in establishing any figures for content of the cord, since the correction for this is a local operation and can hardly be made in general terms.

The effect of size of timber from which the wood is cut remains to be considered. This is one of the more important factors and if its effect can be isolated, this will be an important step in determining the true content of the cord under a given set of conditions, even if we are unable to define the effect of some other factors.

It must be noted that a determination of the board foot content of the cord must be based, not on the board foot content of the individual bolts in the cord (since no lumber can be sawn out of a 4-foot bolt), but on the board foot content of the logs which, when cut into bolts of 4 feet or other length, make up the cord. Any measurement of board foot content per cord must provide for this. Measurement of cubic foot content per cord is simpler; cubic content can be based on direct measurement of bolts as piled in the cord.

Before examining the effect of size of wood on the content of the cord, it is necessary to consider the practical objects in a determination of the content of the cord. These are:

1. To secure estimates of standing timber in cords, and to know what re

lation the estimate in cords bears to estimate in board feet or cubic feet for different sizes of timber, or for component parts of the same stand.

2. To determine the quantity of wood in board feet, or in cubic feet, contained in cords of stacked wood, cut in the ordinary course of logging operations.

The first object requires the determination of the relation between cords and board feet, or cubic feet, for trees of different diameter classes, so that the varying relation may be applied to the different diameter classes of trees making up the stand table, thus obtaining an average figure for the content of the cord for that particular stand of timber. The relation between content of the cord and size of tree may be determined by measuring the board foot or cubic foot content of a number of cords, each cord being made up of trees of the same diameter class.

The second object is not so easy of attainment. Just how to relate size of wood to the content of the cord in cutting operations is the question. There is no difficulty in determining an average content of the cord for the timber on the area where cutting operations are progressing, provided we have an inventory by diameter classes and the content of the cord for the different diameter classes, as above noted. However, if the wood cut does not correspond in size with the wood included in such inventory, the average content of the cord so determined does not apply to the wood cut. It seems necessary, therefore, to secure a direct relation between content of the cord and the size of the wood actually cut and piled in cords. It is hardly feasible to measure the size of the bolts in the piles of wood cut, but the size of the bolts may be expected to bear a relation to the number of bolts per cord, and, since content of the cord varies with the size of the bolts, it should be feasible to establish a relation between the content of the cord and the number of bolts per cord. Once this relation is established, the solid content per cord may be derived from a count, or partial count, of the bolts per cord; provided only that other factors have no disturbing effect.

Work on the content of the cord for the different diameter classes of trees has been done by the Dominion Forest Service, and by the Quebec Forest Service in cooperation with Price Brothers & Co., Ltd. Table 9 gives the results obtained.

TABLE 9

CONTENT OF THE CORD (ROUGH WOOD) FOR DIFFERENT DIAMETER CLASSES

	Cubic feet per cord				Board feet per cord	
	Dom. Forest Service		Quebec Forest Service		Quebec Forest Service	
Diameter, inches	a	b	a	b	a	b
5			198	77	198	297
6			158	78	158	310
7			128	80	128	323
8	91	82	98	81	98	336
9	78	84	86	82	86	349
10	66	86	70	84	70	362
11	60	91	65	85	65	375
12	50	89	53	86	53	388
13	42	85				
14	39	86				
15	33	83				

Columns marked "a" and "b" refer to number of bolts and content of the cord, respectively.

The Dominion Forest Service figures are derived from measurements made in New Brunswick, and the Quebec Forest Service figures from measurements made on the operations of Price Brothers & Company. Since these summaries were made, the Dominion Forest Service has carried out further experiments and fur-

ther data on the subject will shortly be issued.

Data on the content of the cord for 4-foot wood cut and piled in the course of ordinary logging operations were obtained from the same measurements used for study of the cubic foot unit, referred to in Part 1.

Table 10 illustrates the manner in which figures for board foot content per cord are summarized according to the number of bolts per cord, and Table 11 illustrates the same for cubic foot content per cord. Similar summaries have been made for the other three localities.

Table 12 shows the figures for all four localities in which measurements were made. It will be seen that there is a distinct relation between number of board feet per cord and number of bolts per cord, but a definite relation between number of bolts per cord and cubic foot content per cord is not apparent from the material presented.

With equally good piling, the cords in larger wood would contain more cubic feet, since crook and other factors affecting closeness of piling (and so the content of the cord) have, in larger bolts, less effect in proportion to their volume. The result of this is that, other things being equal, the cubic foot content of the cord is greater as the wood is larger, or as the number of bolts is less. However, bad piling tends to reduce the number of bolts packed into the cord and at the same time reduces the quantity of cubic feet in the cord; this may disturb any relation between the number of bolts per cord and the number of cubic feet per cord. This is apart from the effect of other factors mentioned above.

TABLE 10

RELATION OF BOARD FEET PER CORD TO NUMBER OF BOLTS PER CORD FOR 4-FOOT WOOD WITH BARK CUT IN THE ORDINARY COURSE OF LOGGING OPERATIONS

Experimental Measurements Made by Hammermill Paper Company, Matane

	Number of bolts per cord							
	30	40	50	60	70	80	90	100
	Board feet per cord							
	342	387	323	350	292	306	325	288
		391	266	383	370	321	326	
		416	389	374	327	337	298	
			364	273	323	330	317	
			412	323	346	354		
			374	350	349	335		
			373	324	386	355		
			344	332	330			
			382	351				
			383	366				
			417	375				
				320				
				360				
				371				
				349				
Average Board Feet per Cord	342	398	366	346	340	334	316	288

The same factors affect the relation between bolts per cord and board feet per cord, but the variation in board feet per cord for a given variation in number of bolts per cord is such that, while these factors may disturb the relation, they do not mask it altogether.

From the work done, it appears that it may be possible to establish a relation between bolts per cord and board feet per cord that is well enough defined for practical application in woods operations. If for any purpose we must know the board foot equivalent of wood cut in cords, this can be determined from a count of the bolts per cord, provided the necessary general relation is established and provided we are satisfied with a reasonable degree of accuracy. This would be a simpler method than measuring board foot content of logs which, when slashed to 4-foot lengths, make up the cord.

Further work must be done on this and on the relation between bolts per cord and cubic feet per cord, before any final conclusions can be drawn.

TABLE 11

RELATION OF CUBIC FEET PER CORD TO NUMBER OF BOLTS PER CORD FOR 4-FOOT WOOD WITH BARK CUT IN THE ORDINARY COURSE OF LOGGING OPERATIONS

Experimental Measurements Made by Hammermill Paper Co., Matane, P. Q.

	Number of bolts per cord							
	30	40	50	60	70	80	90	100
	Cubic feet per cord [1]							
	74.7	80.0	75.8	59.7	80.8	79.5	81.4	77.6
		75.8	63.6	87.2	87.3	81.5	84.5	
		79.5	85.4	83.3	79.4	84.8	79.5	
			83.3	80.2	80.7	81.7	78.9	
			80.9	72.7	87.9	83.4		
			82.0	81.7	79.3	83.6		
			81.4	59.9	86.1	85.5		
			77.4	82.9	80.4			
			53.3	78.9				
			77.1	80.7				
			81.8	82.9				
				81.4				
				83.3				
				84.9				
				82.0				
Average Cubic Feet per Cord	74.7	78.4	76.5	78.8	82.7	82.8	81.1	77.6

[1] True cubic foot solid content for cord of 128 cubic feet of space.

TABLE 12

SUMMARY OF FIGURES SHOWING RELATION OF BOARD FEET AND CUBIC FEET PER CORD TO NUMBER OF BOLTS PER CORD, BY LOCALITIES

	Number of bolts per cord															Total cords and averages of all cords
	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	
Number of cords measured																
Sautauriski	...	...	...	3	4	10	14	13	6	...	...	...	...	...	...	50
Shipshaw	...	2	1	5	7	11	8	3	5	1	4	...	1	...	...	48
Papanachois	...	...	...	1	3	3	7	1	4	1	1	1	2	3	1	28
Matane	1	3	11	15	8	7	4	1	...	...	...	...	...	...	...	50
	1	5	12	24	22	31	33	18	15	2	5	1	3	3	1	176
Number of board feet per cord																
Sautauriski	...	...	...	320	344	317	300	297	291	...	...	...	...	...	...	306
Shipshaw	...	395	378	406	364	356	332	339	323	316	314	...	311	...	...	351
Papanachois	...	...	...	376	391	351	320	321	305	308	267	251	256	258	262	313
Matane	342	398	366	346	340	334	316	288	...	...	...	...	...	...	...	348
Average	342	396	367	356	356	338	314	305	306	312	305	251	275	258	262	331
Number of cubic feet per cord																
Sautauriski	...	...	...	77	81	78	80	80	78	...	...	...	...	...	...	79
Shipshaw	...	82	80	87	83	85	81	85	83	83	84	...	86	...	...	84
Papanachois	...	...	...	88	90	88	82	83	81	82	76	74	74	78	77	82
Matane	75	78	76	79	83	83	81	78	...	...	...	...	...	...	...	79
Average	75	80	77	81	84	82	81	81	81	83	82	74	78	78	77	81

REVIEWS

The Protection of Woodlands by Natural as Opposed to Artificial Methods. By G. W. St. Clair-Thompson. *223 pp., 1928. London 10/6 Net.*

Forest losses through insects in America have been great and large sums of money have been expended in an effort to control them. Nevertheless many foresters take but a passing interest in the problem, and progress has not been rapid or as effective as might ordinarily be expected.

The title of St. Clair-Thompson's book arouses immediate interest, but unfortunately most foresters will find it difficult to maintain that interest throughout the book. Some 87 of the 223 pages are devoted to a discussion of forest birds, particularly in respect to their distribution, habitat, food, and economic status. The reviewer fully recognizes the importance of birds in controlling insect epidemics, but it does seem, considering the title of the book, that the portion dealing with birds might have been more direct and to the point.

Some forty pages devoted to a discussion of forest animals, while interesting, are not especially applicable to American conditions, since our forest practice is not equally dominated by the sporting value of such animals.

In the opinion of the reviewer, Chapter IV, Practical Forest Protection, is by far the most interesting portion of the book. Many readers, however, will probably question the practicability of some of the suggestions. Nevertheless the author is to be congratulated that he emphasizes natural rather than artificial protection.

Two distinct phases of natural protection are recognized. One of these deals with the silvicultural prevention of damage by stimulating the crop in its most vigorous growth, and at the same time producing as far as possible an unfavorable state for the development of the parasite. Such methods are admittedly only partially effective against insects and of little, if any, use in practice against injurious birds or animals.

The second phase of natural protection deals with biological control, by means of which the beneficial organisms are encouraged and their enemies suppressed. It is generally considered that the encouragement of useful insects is more difficult and altogether less satisfactory than that of predaceous birds. As a matter of fact the encouragement of predaceous birds is St. Clair-Thompson's main thesis and the arguments which he presents supporting it are convincing. It seems strange indeed that this subject has not received more attention by American forest entomologists.

Two phases of artificial protection are also recognized, one dealing with the prevention of damage by exclusion and the other by the destruction of injurious insects, birds, and animals by mechanical or chemical means. These methods have limited application only and are as a rule

rather expensive and generally less effectual than natural protection.

It would be unfair to the author not to call attention to the fact that conditions prevailing in the British Isles and in North America differ tremendously in regard to the composition of the forest, its use in connection with the chase, and the economic conditions governing the carrying out of protective measures. The reviewer is certain that the criticisms he has made of the book may easily be accounted for by these different conditions.

Every forester in this country, whether directly concerned or not with the control of forest insects or pests may read this book with profit. New vistas will be opened to him; he will become more sympathetic with the problem, and particularly with the forest entomologist; and he will, it is hoped, be more ready to support measures dealing with study and control of insects, fungi, and the higher animals.

HENRY SCHMITZ.

Locomotive Sparks. By L. W. Wallace. *Pp. 4; American Society of Mechanical Engineers. New York. May, 1928.*

This paper was read before the spring meeting of the American Society of Mechanical Engineers in May, 1928, at Pittsburgh. In it the author alleges that railroads are unduly blamed for fires along their rights of way, and gives data to show that locomotive sparks can be responsible for but few of the fires attributed to railroads in foresters' classifications of fire causes. It is his belief that under the most favorable circumstances it is very unlikely that a spark of sufficient size and temperature ever reaches the ground in a condition to ignite even the most inflammable material beyond 65 feet from the center of the track. Because so many factors influence the distribution of sparks, the author believes no one is justified in drawing any general conclusions from mere observation. He cites locomotive and laboratory tests covering tens of thousands of observations which he believes sufficient to lay down fundamental and incontrovertible laws on the behavior of locomotive sparks. He itemizes his observations as to high temperatures, spark temperatures, color as a basis of judging ignition properties of sparks, atmospheric conditions, and character of coal.

"So low is the temperature of a spark upon leaving the stack," says the author, "and so rapidly does it cool, that conditions have to be extraordinarily favorable for it to ignite any inflammable upon reaching the ground, and certainly it does not reach the ground in such a state as to ignite inflammables beyond 50 feet from the center of the track under high atmospheric temperatures."

Relative humidity, he says, "can be reduced from 60 to 25 per cent without any material effect upon the action of 3/16-inch sparks, under constant conditions," and, "moisture content (of duff) is a more reliable index to the degree of inflammability than relative humidity, and hence should be given greater credence in litigation."

In closing, he quotes a former member of a State Supreme Court, to whom his results were referred, thus: "The railroads should see to it that the great work which has been done is continued. It is scientifically demonstrated that the much reviled spark has generally had nothing

to do in causing most of those fires alleged to have been started by locomotive sparks. If this scientific work is continued to its logical conclusion it would be accepted in court as *prima facie* evidence as are weather reports and therefore without the prerogative of the jury to pass arbitrary judgment."

EMANUEL FRITZ.

The Abney Level Handbook. By H. A. Calkins and J. B. Yule. *U. S. Forest Service (Unnumbered Bulletin of U. S. D. A.), 1927. Pp. 44, Fig. 27, Tables 5. Government Printing Office.*

This is one of the most directly useful bulletins of the United States Forest Service. To the authors and their earlier colleagues goes much of the credit for improving the abney level and its use, a development that is unique in the art of land surveying. There is no mystery in this method but it is difficult for the forestry recruit often to grasp it. The authors have succeeded in describing the use of the abney level and "trailer" tape in a most clear and concise manner. The clear and illuminating line cut figures deserve special commendation.

Chapter one is an introduction. Chapter two describes the abney level and topographic or "trailer" tape. Chapter three gives adjustments for the level. Chapter four gives uses, and chapter five gives tables for converting slope distances to horizontal distances and tables of equivalents for the graduations of the abney limbs. Chapter four is the largest and most complete. Every step and possibility in the use of an abney level is considered—the location of roads and trails, measuring tree heights, topographic surveys, field notes, and other important details.

EMANUEL FRITZ.

Atlas of the Commercial Woods of the United States. By H. P. Brown. *Bulletin of New York State College of Forestry, Syracuse, New York; September, 1928; Volume 1, Number 4; pp. 66; pl. 60.*

This is a most unusual bulletin in the field of wood technology. There are only two pages of text, and these are in the form of a preface, and there is a two page index. Sixty pages are given up to half-tone plates of photomicrographs of the transverse sections of the principal commercial woods of this country. There is one plate on a page, each plate measuring about 4½ x 6½ inches. The plates themselves are of the negative type which makes the wood substance appear white on a black background; in other words, the cell openings appear as black shadows as they would appear when one looks at the end of a block of wood through a hand lens. The bulletin is thus solely an aggregation of reproductions of photomicrographs with no text with each plate except a title.

Such a bulletin is of the greatest assistance to the instructor in wood technology or nature study, and of course also to the lumberman who is attempting to learn the identification of species. Naturally, with each wood being represented by only one plate, its range of differences cannot be covered, but with the exception of very few, the reviewer believes that the specimens represented

are quite typical of the general run of the species covered. Dr. Brown deserves the thanks of wood technologists and others interested in wood for the publication of the valuable photomicrographs that he has assembled over a long period of time. Incidentally, the printing is on excellent paper, giving each plate considerable artistic merit, and as one runs over the pages one is impressed with the artistic possibilities of such enlarged photographs as backgrounds for advertising matter or other art use.

EMANUEL FRITZ.

Standards and Specifications in the Wood-Using Industries. *Bureau of Standards, Miscellaneous Publications No. 79. Pp. 349, fig. 145. Government Printing Office, Washington, D. C., 1927.*

"This volume represents the first attempt on the part of the Department of Commerce to collect and publish the substance of the standards and specifications in the wood-using industries formulated by the national technical societies, the trade associations having national recognition, or other organizations which speak for industry or with the authority of the Federal Government as a whole." This is therefore a most useful publication, despite the fact that some of the standards and specifications are often disregarded by the members of the agencies promulgating them, and that some are still in dispute or a state of change.

There are several parts. In the first are presented standards and specifications for timber and other unmanufactured or partly manufactured wood such as specifications for cross ties, posts, poles, piling, lath, and shingles, and specifications for preservatives and preservative treatments of wood. In the second part are grading rules of lumber associations and other organizations for grading lumber for building and factory use including, of course, the "worked" items—flooring, ceiling, moldings, siding, and others, as well as structural timbers and special stock. Part three gives specifications for manufactures of wood—barrels, boxes, baskets, millwork, tanks, implement handles, ladders, and others. The fourth part gives specifications for wood furniture, largely government specifications. The next part deals with specifications for various types of paper and paper products except printed matter.

Not in giving a historical summary of the lumber standardization movement, but rather in showing the present status of that movement (standardization), and emphasizing the degree of success already attained by the industry in unifying its grading rules and conforming to the dimensional standards set up within the industry itself, resides the value of the compilation presented in this volume.

EMANUEL FRITZ.

Defects in Timber Caused by Insects. By Thomas E. Snyder, Bureau of Entomology. *U. S. D. A. Department Bulletin No. 1490. Pp. 46; Fig. 45. Government Printing Office, Washington, D. C. July, 1927.*

Lumbermen and wood using industries are showing an increasing and more intelligent interest in controlling the damage done by insects to lumber or lumber products. Mr. Snyder's bulletin is there-

fore a very timely one. It is in a semi-technical style and describes the defects caused by insects, names the insects likely responsible for the damage, and suggests methods of control. By means of a large number of excellent half-tones the various types of insect damages are made recognizable. Description and classification of insect-caused defects is according to the character of the insect galleries and consequent effects. The principal types are pinholes, grub holes, and powder post. These are again classified and described according to whether or not they were caused before or after felling or by the particular class of insect responsible. The space allotted each type of defect is necessarily brief but many references are given from which one may obtain further data.

EMANUEL FRITZ.

Some Commercial Softwoods of British Columbia; Their Mechanical and Physical Properties. By T. A. McElhanney and R. S. Perry. *Forest Products Service (Canada) Bulletin No. 78. Pp. 44, Fig. 16, Diag. 5, Tables 11. King's Printer, Ottawa, 1927.*

The object of this bulletin is "to provide reliable data on some of the principal commercial timbers of British Columbia for the information of architects, engineers, contractors, wood-working plants, corporations, and others who require detailed information regarding these timbers and a means of comparing their respective properties." The bulletin is of interest in the United States because the timbers considered occur in both countries. The authors wisely call attention to the great variation in samples of the wood of a tree species and warn the reader that "the figures given may be somewhat altered when a larger and more completely representative number of shipments has been tested." Eight species are dealt with, and the number of trees represented in the samples tested varies from six in the case of amabilis fir to twenty-one for western hemlock (no figures given for red cedar). For certain species, Douglas fir for example, in which the variation is so wide, a very large number of trees should be represented, in fact even then a species average would be highly deceptive. Such an average would give too low values for material specially selected for structural purposes and would give an erroneous conclusion concerning that material which, because of its softness and lighter weight, is useful principally for interior trim. Such a wood in the opinion of the reviewer, should be divided into classes based upon density irrespective of regional source. It is notable in the author's summary table of strength property that a species average is not given for Douglas fir.

This Canadian bulletin matches the somewhat similar bulletin of the United States Forest Service in strength data given but the presentation of the fewer species is more helpfully arranged. There is the usual general consideration of mechanical and physical properties and a glossary of terms, the latter comprehensive but concise and clear. Under "Tests Conducted and Results Obtained" the test for each major property is described, and the data for all eight species given in a separate table, along with drawings illustrating the character of the test. These separate tables make reference

simpler. Following them, come dissertations on the relation between strength and moisture content, and the graphical representation of comparative results. Each species is given separate description as to distribution, wood structure, strength, durability, and uses. Each wood is also illustrated with a half-tone reproduction of photographs of edge grain, flat grain, cross section, and specimen knots. The samples selected for photographing are particularly typical and it is not difficult at all to recognize the species from the pictures of their typical grain.

Because of the great variety of the wood of Douglas fir, its description might have been more detailed to acquaint engineers and architects with its types and some of its properties to be guarded against, and to give them a basis for a more intelligent estimate of the usefulness and application of this versatile, though if incorrectly used troublesome, wood.

A large folded insert gives a summary in table form of the comparative strength values of the eight British Columbia woods reported upon.

EMANUEL FRITZ.

Forest Fire Insurance in Suomi (Finland). By T. W. Paavonen. *Silva Fennica No. 4, pp. 71-76, Helsinki, 1927.*

Finland, which has a private forest area of 32,800,000 acres, has 16.4 per cent of it protected by forest fire insurance written in two mutual companies. In 1916 there was only 7.1 per cent of the insurable area insured. Both young and old forests can be insured at full value. The insurance coverage also includes felled timber up to 25 per cent of the total volume of timber on the property. Soil fertility can be insured up to 50 per cent of its value.

The fire hazard varies considerably, a ten year average showing that .35 per cent of the insured area is burned over annually. However, it varies from as low as .01 per cent to 1.35 per cent of the area. The annual premium on a five-year policy varies from about 12½ cents per hundred to less than 8 cents per hundred, depending on the hazard. In addition, a membership fee of 5 cents a hundred is charged once and the owner is subject to an assessment of three times his annual premium. It has never been necessary to levy such an assessment.

P. A. HERBERT

Studier över Skogsproduktion å några avdikade torvmarker inom Västerbottenskustland. (A study of Forest Production on Some Drained Peat Soils in the Västerbotten Coastland.) By Paul Börjeson. *Svenska Skogsvårdsföreningens Tidskrift, No. 2, 1927, pp. 273-332.*

A criticism often heard of studies made on the increased growth rate in swamp forests after drainage is that the data obtained cover only a few years following drainage. No assurance is thus given that the oftentimes phenomenal increased growth rate found will continue for any appreciable length of time.

In this Swedish investigation are given measurements on 16 sample plots representing the average growth conditions on

8 scattered tracts which were drained by private companies over 20 years ago to increase the forest producing capacity of their land. One large lumber company interested in improving its forests has invested almost $170,000 during the past 25 years to dig 10,000 miles of new ditch, clean out 180 miles of old ditch, and clean 110 miles of creek-beds. The Swedish government also goes in for forest drainage. During the period 1875-1920, more than a million dollars has been spent for drainage purposes on the national forests.

The present study deals with areas lying in the south part of the northernmost third of Sweden. Their location on a coastal plain gives them an elevation of about 60 feet above sea-level. Before drainage most of the areas bore at least a scattered stand of trees, chiefly pine. A few were treeless. The peat is generally 2 feet deep (1 to 10 feet range), resting on fine sand bottoms.

Method of Investigation. Quarter-acre sample plots were laid out in stands which were typical of the swamp area rather than in those showing the best results obtained by the ditching. The following data were recorded for each plot:

Plot No.
Location
Area (usually about a quarter acre)
Distance from ditch
Topography
Year of ditching
Character of area and age of stand at time of ditching
Soil moisture (fresh, moist, compact, or open)
Peat profile
Present surface vegetation
Present appearance and age of stand
Density of stocking (in tenths)
Estimating the stand—100% cruise of all trees 2 cm. D. B. H. and over, kept by 4 cm. classes. By boring every third or sometimes fifth tree, the D. B. H. for a period ten years before ditching and two ten-year periods after were obtained. The present age, height, and form point for these trees were also determined. Since time and the permanence of the sample plots did not permit cutting the sample trees down to get the various periodic heights and form points of each sample tree, curves of height over D. B. H. and form point over D. B. H. were made of the present values and the periodic values read from these. The investigator admits the error introduced but believes that the excess due to height acceleration may be compensated for by loss in form factor.
Effect of ditching. Example: Through ditching, an unproductive marsh has been changed in twenty years to site IV (eight sites used). To express this in volume, the wood producing capacity of the soil has been raised from a fifth of a cord per acre per year to one cord per acre per year during the last twenty years.

Site Determination. With such unevenness of height and age as usually is found in swamp forests, the judging of the site is a difficult problem. The following method was found to indicate the site satisfactorily. Since the volume increment per cent for definite age classes has already been found to be practically the same for all sites, it was thought justifiable to use the volume increment per cent in this problem as a guide for determining a so-called "management" age for each swamp stand. This is because the actual age of a swamp stand is generally greater than a stand of similar volume which has grown under less swampy (more favorable) conditions. By computing the volume increment per cent for each stand, the actual age of the stand can then be decreased to a management age which is taken from a curve "volume increment per cent over age" already worked out for all sites.

With the management age determined, the stand can be compared with existing empirical tables of yield for judging the site through the mean annual increment. (Site class in several cases modified by judgment.)

Results. In the following table are summarized the facts concerning the sixteen plots:

It is of interest to note the account of E. Haglund, a swamp ecologist, on this region which he visited fifteen years before the forester, P. Börjeson, made the present study. ("Some observations upon the forest growth on drained swamps in Västerbotten," by E. Haglund. Svenska Mosskulturföreningens Tidskrift, Vol. 25, 1911.) Haglund

Plot No.	Age		Year of drainage	Mean annual increment Cords per acre		Site (8 sites used)	
	Actual	Mgt.		Before	After	Before drainage	After drainage
Pine							
R-1	80	45	1904	1/9	3/4	VIII	IV-V
2	88	...	1906	1/50	1/10	Heath Moor	Improved
3	36	30	1906	1/25	3/5	" "	V
4	50	30	1906	1/30	9/10	" "	IV
5	66	45	1907	1/7	3/5	VIII	V
6	71	50	1906–7	1/10	9/10	Heath Moor	IV
7	85	40	1905	1/12	1 1/4	" "	III-IV
8	62	45	1905	1/11	1/2	" "	IV
9	135	70	1907	1/11	4/10	" "	V
10	105	60	1905	1/8	3/5	Moor	V
11	56	45	1862	...	1 1/4	Treeless Moor	III-IV
12	81	60	1903–9	1/5	4/5	VIII	IV
A	63	40	1911	1/18	9/10	Heath Moor	III-IV
H-1	32	30	1887	...	2	Treeless Marsh	II
Spruce							
2	50	40	1904	1/7	1 1/4	Moor	III-IV
S	83	40	1907–8	1/10	1	Heath Moor	III

In all except two of the sixteen plots, one can state that the soil has not yet reached the optimum productive ability which it will in the course of time, provided the ditches are kept in order. The site will probably be raised another class on most of the plots.

was impressed with the amount of money being invested in drainage here, yet he felt confident from the appearance of the earliest ditched areas, that the undertaking would be successful. The present study confirms this.

James L. Averell.

NOTES

The Younger Generation Speaks

The editorial and articles on forest education in the Journal of Forestry for March, 1927, precipitated an animated and at times somewhat heated discussion of the forest schools and their product. Now that the heat of these discussions has largely abated, the following statements, both of which were prepared some time ago, can perhaps be printed as representing the reaction of two of the "younger generation" without danger of adding fuel to the flames.—Editor.

One Youth's Reaction

The discussion of the problem of forest education owes its inception, I take it, to a dissatisfaction among certain members of the profession with the quality of recent graduates of forest schools. The younger generation of foresters is incompetent, is the charge; the blame is laid primarily at the feet of the forest schools.

As a recent graduate of a forest school, I agree neither with the tone, approach, nor logic of the discussion so far advanced. In the first place, the supposition that present forest school graduates are not well-grounded is poorly supported. In the face of the great strides made in forest education during the past two decades, it is not to be accepted casually that the present graduates of forest schools go out with less training than those of twenty years ago. Judged by specialists with ten or more years' experience in their respective lines, the training of the forest school graduate is indeed superficial, and considering the ramifications of the science of forestry no more than a comparatively superficial knowledge is to be expected of two years' intensive training. That the training of foresters leaves much to be desired is not to be denied, but that, in comparison with any past group, or any similar group at the present time, foresters receive less and poorer school training is a premise not supported by the facts.

The attack on the quality of the men holding the chairs of forestry in our schools is, in my opinion, unwarranted. Teaching to the forester holds not only an opportunity for settled life which is so often lacking in the non-teaching section of the profession, but it offers also remuneration which compares very favorably with that obtained in other lines of forestry work. As a result the forestry schools should have, and actually have, received the pick of the profession and not its dregs, as has been intimated. Compare from every standpoint the faculties of our leading forest schools and they measure up and over the rank and file of the profession. Or compare the teachers of forestry and their standing within the profession with the teachers in any other profession and their standing in their respective professions, and the only conclusion which may be drawn will be that forestry is particularly fortunate in obtaining the services of so many outstanding professional members to train the oncoming youth. If forestry graduates are receiving inadequate train-

ing the reason lies, primarily, in the underdevelopment of the forestry sciences and not in the character, experience, or training of the teachers.

I believe that the critics are headed in the wrong direction. They find fault with the training of the men while in reality their criticism is of the personality, ambition, and stamina of the men who stick. Forest schools can train only those who apply at their doors and they cannot pick and choose among the applicants; they can neither remake weakly souls nor instill in them a superior spirit; they may send out good men but they cannot guarantee that they will remain in the profession. That is up to the profession, and the opportunities which the profession affords. No one expects a worker of clay to impart to his product the properties of steel; no more can the forestry teacher from weak material turn out a strong product.

Verily, conditions have changed and the only change has not been in the attitude of mind of the American youth. That, in fact, has very little to do with it. Men enter forestry (or any other profession) because to them it offers more than any other line of work. They stay in it so long as it makes good its offer, and no longer. In 1906 a young forester could look forward to a responsible position in four or five years, carrying with it not only a respectable salary for those times, but, more than this, responsibility, trust, and a feeling of success. The youth of then are now middle-aged, and, middle-aged, have lost their trust in youth. Now these one time supervisors at twenty-five years, state foresters at thirty, look, with distrust, at the honest attempts of young men to rise *rapidly*. The young forester of today must down his ambition, forget his dreams, and settle down to years of uninteresting routine, serving his allotted run of years, until age gives him sense and the right to step upward. And why so—because there is no demand for men, no jobs to fill? No, we are assured of the steady clamor for more good men. But responsible foresters of today must have age and its mellowing influence. Forget the yesteryear when beardless boys made policies that stand and have stood for so much. This is another day; men are no longer what they were.

"But," I hear a voice, "the forestry profession is expanding mightily, and even if the condition you speak of is true, the new jobs which are daily becoming available certainly offer many wonderful opportunities." Yes, there is a good demand, but an overabundant supply. The forestry profession can absorb only a small percentage of the graduating classes and with the desire for jobs and the competition so great, the young forester feels little of this development. "But," continues the voice, "surely you will not deny that the profession and the men in the profession give young foresters every opportunity in their power." In return I say, "Sir, that may be true, and I really cannot judge, but this thought occurs to me: are you, by any chance, the man who referred to the young, guileless, thirsty, anxious, nervous men, on their first jobs, as rotten?"

The forestry profession has lost its trust in youth. The responsible jobs are not filled by young men, but by older men often of no forestry training, and frequently men who have been tried once and were found wanting. Up until a few

years ago a distinctly youthful profession, the reaction has now set in. A forester must be a graybeard to rise. For proof look to the policy of the federal forest service in placing young graduates of forest schools in sub-ranger and ranger positions for several years, *and officially encouraging them to remain there.* A fine ducking for lofty ambition! Would your present high officials have stood it out? Perhaps, and then again, perhaps not! Remember, no exceptions—the grind for all youngsters.

A man from whom little is expected is liable to produce little, a man whose responsibilities are few cannot react to do big things. A young forester sees himself not only as a forester but as a man with a mark to make in life, comparing himself always to men in other walks of life. If he is worth his salt, he is bound to resent a position where his chances to advance rapidly are minute and where his superiors look unfavorably on a natural desire to rise and get ahead. And they do resent it! They resent it to the loss of the profession. *Most of the better men coming out of forest schools are leaving forestry.* At least the better men coming out of one forest school are leaving forestry, if one young man can judge another or trust the judgment of a teacher; going into other lines of work where remuneration and even opportunities for public service are greater. The older men do not, perhaps, realize this; the younger men as a whole do, because they know their classmates and follow their fortunes.

Two men in particular come to my mind. Both rose to high positions in the Army during the war. Subsequently they studied forestry, became leading students, and entered the profession. Two years in minor positions with few responsibilities were enough. Both are now out of forestry.

If forestry wants the slow-plodding type of man it should follow its present method of handling its youth. If, however, it wants the keen, exceptional, quick-to-think and quick-to-do-type, which once characterized the ranks of the profession, it must give equal opportunities for the exceptional man to do his stuff, *to rise, to stick.*

Speaking for myself I am fairly well satisfied with my contemporaries. I am, from my narrow horizon, watching two exceptional young men who, in all other ways but one, are perfectly normal. In just one way they are different; they are "hipped" on forestry. That's why they stick. There are others too, and in that failing rests the future of the profession. If they weren't off on the subject they would quit today. But to return to these two; being queer on forestry they will stick it out, and in ten or fifteen or twenty years they will get their heads above the mob, and then watch them! Barring untimely death I firmly believe that they will do as much in forestry during the next twenty years as any other individual has in the past.

I would like to quote you a parable. A man had an uneven-aged woodlot of good species and sound seedling origin. His older age classes were approaching maturity and their crowns were all about even with only here and there an outstanding tree. He had hacked around here and there, taking out dead wood and dying trees, but he had never given the wood a real honest-to-goodness improvement cutting. One day he visited

his woodlot and pausing he began to observe, and, observing, he became dissatisfied with his younger trees. They really didn't look thrifty. It bothered him exceedingly. Quoth he, "I have a woodlot now, a fairly good woodlot, in all, with some mighty fine specimens which I am proud of, but, prithee, if my young stock is poor, what of the morrow?" And he pondered, and, pondering, he considered the seed from which the stock had sprung to find the reason for his poor, sickly, rotten-appearing saplings. He got nowhere there, however, because he soon decided that they couldn't have inherited their weakness, for they were of the selfsame species and strain as the older trees. Then he considered the soil, but considering, he said, "The soil must be all right because in this same soil my pride, the older trees, started, received their early nourishment, and thenceforth flourished." And then the old fellow was in a quandary, for, you see, he wasn't much of a forester and out of his sphere, as it were. The more he looked at the young trees the more perplexed he became that they should be so listless looking, so sallow. Finally, he was about to give it up when his eyes glanced higher, and, glancing, he was struck with something which he had never seen before. Taking his older trees, he saw that they were, *in general,* good and so hitherto he had considered them all good. But now considering them more closely, as individuals, he noticed that some were weak and deformed and some were poor specimens, and that as a whole they were quite thick, too thick perhaps for the good of those underneath. There were also some of a different species, and they all conspired, thoughtlessly (for trees don't think, you know) to keep the light from the ground beneath. Slowly upon the owner's mind came an idea, and being a man of action he grabbed his axe and began a good, old-fashioned improvement cutting in the woodlot. He took out the defective trees and put them to use on his farm. He thinned out the older trees and let the light down beneath. Being an economist, he didn't care much for the feelings of the older, defective trees but slashed away. The young trees responded well and before long by careful thinning and good care his young trees came through nicely, filled in the gaps, and he had a fine healthy woods with both the young and the middle-aged developing well together. He managed his forest on the selective system, as best suited to the species and conditions, and even when the middle-aged trees grew old and were removed he had plenty to take their place. In fact, by use of the axe, coupled with some common sense, he soon had a fairly good example of the selection forest. The seedlings were all right in the beginning, they had received a good start, *but they had lacked light.*

Young foresters need more education, more training, but more than all else they need a chance; they need light from from above. Give it to them and they will respond. Age has no corner on the ability to think—the Man who left the greatest impression on our life lived just thirty-three years.

Now, to sum up my wandering observations. It has been said that the younger men are weak, are failing, and that, obviously, the forest schools are to blame. Not at all, say I, but the profession and the policies controlling the profession. The forestry directors, some short time ago, decided that we must have better grounded men. Thrust them into the

earth for the first ten or twelve years and they should emerge satisfactorily dirty. That was the idea. The better grade of young men didn't mind starting at the ground level, *but they resented being buried!* They quit! Those remaining were somewhat poorer. Youth is rotten says the profession. You can't trust them. The forest schools are no good, that must be the reason.

If there is a problem in the future generation of foresters I do not believe that the remedy lies in classifying or revolutionizing the forest schools. I would suggest another. Heap on the shoulders of the young men all the responsibility which they can bear. That was the old system and it was a pretty good one. Some men will react poorly under such treatment, because, unfortunately, there are weaklings. These men will be forced into jobs of little responsibility and will be satisfied to stay there. The greater number of young men will expand and develop, and as they expand and develop the shoulders of these young men should be burdened with increasing responsibility, even if it is necessary to discharge older but less capable employees to do it. In this way and only in this way will forestry retain and develop its better men.

Can forestry follow such a policy? At least the forestry directors can look at young foresters not as a class but as individuals, each individual closely concerned with his individual development. They can correct the present mistaken idea that preliminary training of a forester necessitates long years in irresponsible positions where he will have no use for his technical training, and where he will probably go stale. They can do that, if they will. They cannot hope, however, to solve the main problem, the problem of state and federal employment, with its ungrateful master, poor pay, haven for the useless, and other phases, a problem facing every form of governmental activity.

There is a solution, however. That solution lies in the development of private forestry. Private enterprise respects ability and relegates ineptitude to its proper place. Private forestry will make forestry a true profession. With private forestry employing ten men to one employed by governmental agencies, this problem of attracting and holding the best type of manhood will fade.

JOHN R. CURRY.

FOREST SCHOOLS AND RECENT GRADUATES

Constant dripping of water wears away the hardest granite. Attacks upon the younger generation's flippancy and lack of morals have now been turned to the lack of professional ability of recent forestry graduates and the failure of the forest schools to develop finished products. Youth merely shrugs his shoulders and goes serenely on his way.

That something radically wrong with the profession exists no sane man can deny. That it is mostly because of the forest schools and lack of mentality in their graduates the writer will not permit to go unchallenged.

The writer does not belong to "the few hair-brained enthusiasts that stormed the doors of the first forest schools." Neither is he a very recent graduate, as it is eleven years since his senior class walked out of the lecture room to forsake the intricate mazes of 1. op.^{n} for those of the ballistic paths of trajectories.

In the decade that has passed he has achieved neither fame in his profession nor additional degrees other than the simple bachelor's degree awarded *in absentia* while in the service. Perhaps he is the most unknown member of the Society; most certainly he has had no experience in the practice of scientific forestry, being engaged in the logging end of the utilization game. However, with the nonchalance of the A. E. F. he views with suspicion all criticisms of youth and knows from experience that all that is European is not perfect.

The first forest schools in this country naturally had to be built on the experience of Europe, but alas they have continued to a great degree to follow along the same line. These "hair-brained" enthusiasts graduated in the course of time and were quickly assimilated into the newly founded schools and the federal and state services. Personnel was scarce and new positions were constantly being created. Appropriations were meager, but these same enthusiasts had the opportunity (very scarce today) to head departments, or at least divisions of departments, and to experiment at the cost of the tax-payers. Can they today look back and say that their opportunity was used to the limit? Have they in the light of retrospect given the newer generation all that they might have? Would the present antagonism (it still exists) of the lumber operators to the forestry movement be alive if the enthusiasts had had a little tolerance and sympathy when they first began to tighten the screws and endeavored to secure a protective attitude towards the forests? Were not they carried away with their new found authority and the love of their calling so much as to forget that old habits are hard to change and all things are feared that are not understood? Did not these self-same enthusiasts make mistakes that history records and that today appear inexcusable?

There are not too many forest schools nor too many graduates. If the schools have not risen to the height that they should, and we all must admit that this is true, the fault lies not entirely with their faculties, nor the recent graduates, but with the older alumni and the leaders in the profession. What help have they given?

The comparison of forestry to engineering or law is not just. Engineering is a basic science. Law has been developed through the ages. The engineer knows today, tomorrow, and forever that 3.1416 multiplied by the diameter equals the circumference of the circle; that in Alaska, Madagascar, and Afghanistan mass times the velocity gives momentum; that in summer or winter the smaller the angle the closer the sine and tangent approach one another.

What in forestry can be compared to these immutable laws of engineering? Broadcast burning in the Douglas fir region is best for germination. Fir will not germinate successfully on any but the bare mineral soil. Light burning in the western yellow pine region is disastrous, and recently it has been proven that light burning in the longleaf pine region is beneficial. What was the dogma twenty years ago and even ten in respect to burning?

Let the enthusiasts select any ten foresters and have them submit a treatise on forestry, or give ten questions and answers to some of the problems that

confront the profession today. If there is not connivance and collusion, who will admit that even the majority will agree? The fountain can rise no higher than its source. Give us leadership worthy of the name and the younger graduates will follow.

It is true that the schools harp on enrollment too much. However, appropriations are based on enrollment and quantity production invariably produces some quality. The writer does not believe four years is sufficient to gain an education in forestry, but it is hard to keep young men in school longer. He thinks that a year after graduation or even two working at some phase of the game and then taking two or three years at a different institution preparing for a higher degree is the goal we should seek. Perhaps a year of six months in the class room and six months in the field for six years would be even better. However, that is something that time alone can evolve. Rest assured that the forest schools will keep pace with the profession.

None of the enthusiasts value silviculture, protection, and management more than the writer. None had more painstaking teachers who put their life into their work and left an imprint that time cannot mar on their scholars. Yet the writer is old enough to have a mind of his own. He no longer respects opinions because the owner is gray-haired and has long been at the helm. He sees the profession's mistakes, and although not capable of rectifying them he has confidence in the youth of today and in the schools. As time goes on and the enthusiasts retire, European methods will be forgotten, new leaders will arise unhampered by mistakes of their predecessors, and twenty-five years hence the profession will not be asking itself, "What is wrong?" but will be attempting to remedy the evils it finds.

The writer hopes that when that time comes, and the foresters of his generation look back on their own mistakes and negligence, they will not try to sidestep the issue and blame the men who taught them and gave them that rare love of the profession that even today in spite of the failure of the recognized leaders to produce a practicable working plan for the forests, still goes serenely on cleaving to the ideal that was lighted in the class rooms and camp fires of long ago. Youth always carries on.

William J. O'Neil.

International Congress of Forest Experiment Stations

An International Congress of Forest Experiment Stations will be held at Stockholm, from July 22-27, 1929, under the auspices of the Swedish Government and the Swedish Institute of Experimental Forestry. American foresters engaged in research are cordially invited to attend.

The present Congress is the outgrowth of the International Union of Forest Experiment Stations established at Badenweiler in 1891, under the name of "Internationaler Verband forstlicher Versuchsanstalten," or "L'Union internationale des stations de recherches forestières." The function of the union was to discuss at international meetings and conferences questions of importance in the work of forest research, to facilitate the exchange of scientific ideas between the different institutes, and, wherever

possible, to work out standard methods for the carrying out of forest investigations.

The last meeting of the Association, the sixth so far held, took place at Brussels in 1910. Delegates from 24 different countries, including the United States, attended this conference, and it was resolved that the next meeting should be held in Hungary in 1914. The Great War however intervened, with the result that the International Union of Forest Experiment Stations has not had a general meeting since the Brussels conference of 1910.

Immediately before the International Forestry Congress at Rome in 1926, however, a small conference was held in Zürich, to which were invited representatives of experiment stations in Denmark, Finland, France, Germany, Norway, Sweden, Switzerland, and the United States. At this meeting it was resolved, among other things, to revive the International Union of Forest Experiment Stations. The Director of the Swedish Institute of Experimental Forestry was elected President of the Association and was commissioned to summon a congress at Stockholm in 1928 or 1929. During the Congress in Rome the matter was further discussed and keen sympathy with the idea of a Congress of Forestry Experiment Stations in Stockholm was expressed in several quarters, as for instance by delegates from the countries represented at Zürich, as well as by England, Holland, Italy, Yugo-Slavia, Poland, and Czechoslovakia.

The Congress will be opened in Stockholm in the College of Forestry on Monday, July 22, 1929, and will continue until July 27. The preliminary program includes the following subjects for discussion:

Reorganization of the International Union of Forest Experiment Stations and the adoption of rules whereby it shall be governed.

Arrangement for an international bibliography of forestry.

Discussion on the question of the standardization of measuring methods and the investigation of experimental plots.

Discussion on methods and terminology in the sphere of forestry soil science.

Addresses describing the progress of silvicultural research.

Prior to the Congress a trip through southern and central Sweden will be arranged, lasting about a week, and after the Congress there will likewise be a week's excursion in northern Sweden. The purpose of the excursions is to demonstrate the different forest regions in Sweden and the silvicultural methods employed therein, and also the Experimental Institute's scientific field work. During the Congress there will also be short excursions to forests in the vicinity of Stockholm.

Correspondence concerning the Congress should be addressed to Prof. Henrik Hesselman, Statens Skogsförsöksanstalt, Experimentalfältet, Sweden.

"Berlin Green Week," 1929

The annual agricultural exposition known as the "Berlin Green Week" will be held in the German capital for the fourth time from January 26 to February 3, 1929. The exposition, which will be of a comprehensive character, will comprise departments devoted to

agriculture (with several sections), milk, forestry, rural housekeeping, poultry, and bee-culture. Coincident with it will be the German Hunting Exhibition, the International Marksmen's Exhibition, and an exhibition covering "Fishing and Angling Sports," the latter terminating February 10. The whole will occupy a space, indoors and out, of about 42,000 square meters.

The forestry portion of the exposition was a special center of attraction this year and is believed to have furthered materially the objective of making the work of the forester and the economic value of the forests of the country more widely known to the German people.

While particulars respecting the forestry exhibit for 1929 are not as yet at hand, it is anticipated that it will exceed, in extent and interest, the display of the previous year.

Inquiries regarding the exposition should be addressed to Ausstellungs-, Messe- und Fremdenverkehrs-amt der Stadt Berlin, 23 Königin Elisabeth Strasse, Berlin-Charlottenburg.

Trends of Pulpwood Prices in New England[1]

The f. o. b. mill prices of rough and peeled spruce pulpwood in New England between 1921 and the present are shown in the following table for each quarter. These prices are taken from the statistics gathered in past years by the Woodlands Section of the American Paper and Pulp Association. The yearly averages have changed but little during this period. The rather wide quarterly variations seem to compensate during the course of the year.

Spruce Pulpwood Prices, F. O. B. Mill, New England, 1921-1928

Date	Rough	Peeled
1928—1st Quarter	$15.25	$18.04
2d Quarter	14.47	18.12
1926—1st Quarter	$15.10	$18.31
2d Quarter	14.13	17.78
3d Quarter	15.58	18.19
Average	$14.60	$18.09
1925—1st Quarter	$14.86	$17.08
2d Quarter	13.66	16.90
3d Quarter	15.63	17.46
Average	$14.72	$17.15
1924—1st Quarter	$13.75	$16.96
2d Quarter	15.54	17.97
3d Quarter	17.50	19.00
4th Quarter	15.16	17.50
Average	$15.49	$17.86
1923—1st Quarter	$16.00	$17.90
2d Quarter	17.66	18.83
3d Quarter	14.80	17.79
4th Quarter	14.00	17.15
Average	$15.62	$17.92
1922—2d Quarter	$15.37	$20.25
3d Quarter	14.25	17.50
4th Quarter	16.00	17.90
Average	$15.21	$18.55
1921—3d Quarter	$15.25	$18.10
4th Quarter	14.50	18.31
Average	$14.88	$18.21

Forestry Investigations Proposed by the Paper Industry[2]

The American Paper and Pulp Association, through its Woodlands Section, of which Charles W. Boyce is Secretary-Forester, proposes as part of

[1] "Pulpwood," Vol. 1, No. 3.

[2] "Pulpwood," Vol. 1, No. 4.

the 1928-1929 program of that Section, to conduct two projects bearing upon forest practice. The first is a survey of progress in forestry in the pulp and paper industry. It will be conducted under the auspices of the Society of American Foresters as a part of the Society's nation-wide study of commercial forestry, and in cooperation also with the Forest Service and the National Lumber Manufacturers' Association. The second project is a study of the economic feasibility of forestry as related to the pulp and paper industry. If possible each major pulpwood region will be studied. For this purpose, the study will be reduced to costs and returns both in terms of pulpwood and forestry and also in terms of wood pulp and paper or mill output. A preliminary outline of this proposed regional study follows:

I. PULPWOOD COSTS IN TERMS OF WOOD PULP PRODUCTION

The purpose of this section is to show the average and range of costs of different kinds of pulpwood and of different sizes and conditions of pulpwood in the primary mill operations to indicate the economic advantages of different species and sizes.

1. Pulp yields by species and processes. (Forest Products Laboratory has done this.)
2. Pulp yields by species and sizes of wood.
3. Barking losses by species and sizes.
4. Yields of sap and heart wood by species and sizes.
5. Solid wood content of cord by species and sizes.
6. Costs of handling wood by species and sizes.
7. Machine efficiency by species and sizes.
8. Consideration of units of measurements more suitable than "cord."

II. TRANSPORTATION COSTS

The purpose of this section is to illustrate the part which transportation costs play in the total cost of pulpwood and in the economic aspects of forestry, and the bearing these costs have upon species, sizes of pulpwood, and the coordination of mill and forests.

1. Average and range of transportation costs between the woods and the mill by regions, and by methods of transportation.
2. Variation in transportation costs by species and sizes in terms of usable wood fibre.
3. Losses in transportation.
    (a) Sinkage in driving.
    (b) Shrinkage.
4. Average and range of costs per cord-mile by different methods of transportation.
    (a) Railroading.
    (b) River driving.
    (c) Trucking, etc.
5. Cost variations by sizes of wood.
6. Maximum and minimum car loads by species and sizes of wood.
7. Relation of transportation costs with mill and forest locations.
    (a) Influence of freight charges on other raw materials.
    (b) Influence of freight charges on finished product to normal consuming centers.

III. WOODS OPERATIONS

The purpose of this section is to bring out the difference in the costs and the variations in the costs of logging wood

of different sizes, and under different forest cutting plans.

1. Methods and machinery of logging by regions.

2. Logging costs by regions.
   (a) Contract prices.
   (b) Company costs.
   (c) Piece work.

3. Logging costs by species and regions.

4. Logging costs by sizes, species, and regions.

5. Probable logging costs under plans that are modified to assist in the regeneration of the forest.

6. Regional labor costs by type of work.

7. Comparison of costs under different conditions with monetary value of the wood for pulp.

IV. GENERAL FOREST SURVEY

The purpose of this section is to gather information upon the forest conditions, pulpwood supply, prices of timberland and standing timber, conditions of ownership, and other items in each of the major pulpwood regions.

1. Regional forest resources and availability for pulp manufacture.
   (a) Contrast with availability for other forms of manufacture.

2. Forest ownership by pulp manufacturers by regions.

3. Forest ownership by companies or individuals which sell stumpage.

4. Timber land and stumpage price trends by species and regions, for pulp and other purposes.

5. Regional and species pulpwood prices in the woods.

6. Regional and company distribution of age classes and forest types (general).

7. Comparison of carrying costs and stumpage values by regions.

V. FOREST ROTATIONS BY REGIONS

The determination of the proper time to cut timber must be based upon growth and deterioration rates and the ages at which the net yields in pulpwood material are the greatest.

1. Regional and species rates of growth.

2. Range in optimum stands by sites, species, and regions.
   (a) By decades.
   (b) By forest types.

3. Regional and species rates of deterioration.
   (a) Periodicity.
   (b) Controllability.

4. Net yields per acre of pulpwood by regions and forest types and by ages.

5. Computation of growth and deterioration trends, by regions and forest types in terms of dollars per year.

6. Analysis of financial factors which have a bearing upon rotation.
   (a) Interest rates.
   (b) Taxes.
   (c) Values, etc.

VI. REPRODUCING THE FOREST

1. Natural means.
   (a) Methods and costs of cutting to assure regrowth of pulpwood species.
   (b) Per cent stocking and time required for regeneration by
      (1) Selection cutting.
      (2) Diameter limit cutting.
      (3) Clear cutting, etc.
   (c) Comparative costs of establishing reproduction by various plans.

(d) Costs and methods of preparing for reproduction.

(1) Hardwood girdling.

(2) Brush disposal.

(3) Swamping, etc.

2. Planting.

(a) Methods and costs of field planting.

(b) Regional and species costs of planting.

(c) Percentages of survival by species and regions. (Related to size and age of stock.)

(d) Costs of spot planting.

(e) Nursery methods and costs.

VII. CARING EOR THE GROWING FOREST

1. Fire protection.

(a) Methods and costs.

(b) Efficiency.

(c) Insurance.

2. Insect and Disease Protection.

(a) Protection against the budworm.

(1) Method and costs.

(2) Determination of average annual loss.

(b) Protection against other pests.

(1) Methods and costs.

(2) Determination of normal losses.

3. Improvement and release cuttings.

(a) Methods and costs.

VIII. RETURNS FROM THE PULPWOOD FOREST

1. Values at the end of the rotation.

(a) Based upon present values.

(b) Based upon value trends.

2. Intermediate returns.

(a) From improvement and thinning cuttings.

(b) Resorts.

(c) Other.

IX. BALANCING COSTS AND RETURNS AND DETERMINATION OF FOREST POLICY

1. Computation of total costs of pulpwood as related to different conditions to bring out average regional costs and ranges.

2. Computation of costs of wood at the mill based upon species, sizes, and other factors which are reflected in the value of the pulp produced.

3. Combination of these two series of figures to show the amount which may be spent from current operating income upon forestry.

4. Determination of forestry practice that promises to yield the highest return in pulpwood.

5. Adjustment between 3 and 4.

Arkansas Forest Protection Association

The second meeting of the Arkansas Forest Protection Association, organized on October 8, 1928, was held at Hot Springs on October 25. The Association came into being as a result of the disastrous fires that swept the state last spring when the situation was so serious that the Forest Service was forced to make an emergency call on the aerial facilities of the Arkansas National Guard to aid in the location and suppression of the many fires occurring on the two National Forests in the state. Private farm lands on which there were excellent growths of young timber were also swept by fire. As one means of preventing a repetition of these experiences, the Arkansas Forest Protection Association has been organized, with the primary object of disseminating authentic

information concerning the damage done by forest fires and the things necessary to prevent their occurrence.

The meeting at Hot Springs was attended by business and professional men not only from all parts of Arkansas but also from adjoining states. The following officers were elected: A. L. Strauss, Malvern, President; L. R. Wilcoxon, Crossett, Vice-President; W. L. Hall, Hot Springs, Secretary-Treasurer. The Board of Directors is composed of these officers and H. C. Couch, Pine Bluff; R. H. Charlton, Hot Springs; F. J. Leeper, Hot Springs; John G. Lonsdale, St. Louis; W. G. Morrow, Camden; and B. S. Cole, Glenwood. Headquarters will be at Hot Springs. Following the lead of similar associations already organized in other states, it was decided to set the annual dues of members at $1.00 so as to enable farmers holding small woodlots, teachers in public schools, civic club members, and the public in general to participate in the activities of the association without having to make any large cash outlay.

Bryant Honored

Prof. Ralph C. Bryant of the Yale School of Forestry received the honorary degree of Doctor of Science from Middlebury College at its commencement in June, 1928.

Forest Supervisors Pass On

District 2 of the Forest Service has recently lost two of its oldest and best known forest supervisors. James A. Blair, Supervisor of the White River National Forest, died suddenly on June 18, while on a field trip, probably as a result of over-exertion. James Blackhall, Supervisor of the Hayden National Forest, died on September 16, after an illness of only a few days, following his return from a forest fire.

Both men had been in the Forest Service for many years and were universally loved and respected by all who knew them.

Windbreaks and Shelterbelts for Maryland

The bulletin entitled "Windbreaks and Shelterbelts for Maryland," written by Fred B. Trenk and published by the Maryland State Department of Forestry under the direction of F. W. Besley, State Forester, shows a fine understanding of the shelterbelt and windbreak situation for those states lying in the Great Plains and Prairie Regions, with the exception of the species recommended for planting. Is Maryland to be classed as a state with similar climatic conditions which make the planting of windbreaks and shelterbelts an absolute necessity?

Professor Quayle, of the University of Wyoming, recommends the use of an iron chain wind gauge to determine the necessity of windbreak planting. When the wind blows the chain out straight, it is a strong wind, but when the links blow off, it is time to plant a windbreak. Having been reared in the State of New York with a general understanding of conditions in the Atlantic States, and having just completed three years' service as Extension Forester in the State of North Dakota where the "links blow

off," I find any windbreak or shelterbelt problem of intense interest.

The author of the bulletin uses as his chief guide Forest Service Bulletin 86, which is a study of windbreaks made by Carlos G. Bates. Information taken from Bates' report and applied to the State of Maryland would probably be incorrect. Mr. Bates confined his study to the states of Kansas, Nebraska, Iowa, and southern Minnesota. These states were chosen for the experimental work because the factors of slope and aspect were eliminated. It was a plains country. Bates found that in extreme cases 70 per cent of the moisture ordinarily lost by evaporation at a single point could be saved by a proper windbreak in Nebraska, and not in Maryland. The Great Plains States are characterized by very dry atmosphere and a range of from 12 to 25 inches in annual rainfall. Because of the dry atmospheric condition and the small amount of rainfall, evaporation is a problem. It does not seem that such conditions would exist in Maryland. It is estimated that about 12 inches of rain is necessary to grow an ordinary crop (grain). Maryland receives an average of 40 to 45 inches annually and the air is moist, so that evaporation should not be a very big problem.

A bulletin prepared primarily for the use of farmers must have the farmer's viewpoint to be effective. Technicality must be done away with and recommendations must be economically sound. It is not economically sound to recommend to the farmers of a state where rainfall is not a limiting factor in tree growth the necessity of cultivation for a period of four or five years, and of irrigating. In the Great Plains States, where all available moisture is needed for tree growth and where weeds if allowed to grow will kill out planted trees, it is found necessary to cultivate until the crowns close in and cover the ground. Even in these states, however, irrigation is not generally recommended to farmers, especially with evergreens, which require only about one-sixth as much moisture as hardwoods.

C. A. Gillett.

Organization of American Standards Association Completed

Reorganization of the American Engineering Standards Committee into the American Standards Association, referred to in the October issue of the Journal, has been completed by the unanimous approval of the thirty-seven member bodies. William J. Serrill, formerly chairman of the Committee, now becomes the president of the new Association. One of the most important results of the abandonment of the committee form of organization will, according to Mr. Serrill, be a much greater degree of participation by trade associations in the direction of the national industrial standardization movement.

The American Engineering Standards Committee was established in 1917 by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society of Testing Materials. Its purpose was to provide a method of cooperation which would prevent duplication in standardization work and the promulgation of conflicting standards.

The United States Government Departments of War, Navy, and Commerce became members of the committee in 1919, and the Departments of Agriculture, Labor, and the Interior somewhat later. New members were added from time to time until there are now 37 member bodies, and in addition 350 sustaining members, including manufacturers, distributors, associations, etc.

The following types of standards are covered by the Association:

1. Nomenclature. Definitions of technical terms used in specifications and contracts and in other technical work.
2. Uniformity in dimensions necessary to secure interchangeability of parts and supplies, and the interworking of apparatus.
3. Quality specifications for materials and equipment.
4. Methods of test.
5. Ratings of machinery and apparatus which establish test limits under specified conditions as a basis of purchase specifications, or which establish requirements as to performance, durability, safety, etc., under operation.
6. The codifying of provisions for safety.
7. Rules for the operation of apparatus and machinery in industrial establishments.
8. Concentration upon the optimum number of types, sizes, and grades of manufactured products.

There are now national standardizing bodies similar to the American Standards Association in 19 foreign countries. The Association is constantly in touch with these, and all standards are exchanged. National standards developed abroad are thus made available in this country for the use of exporters, manufacturers, and others.

Up to the time of the organization of the Association 285 projects had been given official status. Of these 5 had to do with wood and 2 with pulp and paper. The Society of American Foresters has been represented on several sectional committees of the Association.

SOCIETY AFFAIRS

James Girvin Peters

By the death of James Girvin Peters the Society of American Foresters has lost one of its oldest and most eminent members and the cause of American forestry one of its best known leaders. A member of the second class graduated from the Yale Forest School, Girvin Peters was one of the small group of able men fortunately drawn into forestry at the beginning of its rapid development in the United States. Upon graduating from Johns Hopkins in 1900, he went into the lumber business in Oregon, where a chance meeting with Gifford Pinchot turned him quickly to seek preparation for a life work of public service, as a forester. By inheritance he was of the East and the South; by upbringing, urban; but he combined breeding and refinement with a broad Americanism and true democracy, and was born an outdoor man; and these qualities, together with the quality of practical idealism, made forestry a congenial field.

In that field he achieved results that constitute a notable contribution to the national welfare and permanently identify his name with one of the main divisions of the general scheme of public forestry. To his guidance is primarily due the establishment of the principle of Federal and State cooperation as a working instrumentality for effecting the protection of forest lands and the promotion of timber growing. For twenty years his energies were given chiefly to the initiation and furtherance of the cooperative movement; and to his sound judgment, clear vision, and skillful handling must be given the chief credit for bringing it to its present importance as a cardinal public policy.

As a member and officer of the Society of American Foresters, he gave additional evidence of his usefulness and fidelity. Of his conscientious dependableness we, his associates on the present Council of the Society, can speak with finality. While his life came untimely to its conclusion, his work was not left fragmentary or inconclusive, but will stand as a permanent memorial to his devotion, capacity, and discerning tact.

O. M. Butler,
B. A. Chandler,
R. Y. Stuart,
For the Executive Council.

Summer Meeting of New England Section

The annual summer meeting of the New England Section, held at Keene, N. H., was opened at 9:30 A. M., September 4, with a field trip on the Yale Forest under the guidance of Professor J. W. Toumey. About fifty members were present. The field trip was planned so as to visit sample plots and operations, including quadrats employed in the study of root competition, weedings to free natural and planted white pine, underplanting of inferior hardwood stands,

the conversion of a stand of yellow birch, red maple, and other hardwoods to white pine without planting, the group-selection form of stand with pine ranging from 10 to 50 years, the group-shelterwood method of reproduction in white pine, the effects on reproduction from clear cutting white pine, supplementary planting to complete the stocking of natural pine stands, and sample plots in weeded and unweeded pine stands.

In the afternoon a meeting was held in the pine grove near the headquarters building with Chairman E. C. Hirst presiding. E. S. Bryant, Chairman of the Committee on the Improvement of Composition of Stands, outlined the objects of the study, and indicated the progress made to date. In the course of the report he read letters from H. I. Baldwin, Research Forester with the Brown Company, and Howard Churchill of the Finch-Pruyn Company on the subject of girdling hardwoods; and from Professor J. W. Toumey, Professor R. T. Fisher, and G. C. Hawkins on weeding and releasing. A very helpful discussion following the report was entered into by Cary, Tillotson, Behre, Hawley, Hirst, Westveld, Toumey, Hosley, Baldwin, Wilson, Jones, and Reynolds. The meeting was adjourned in time for three specially arranged excursions—one to release cutting sample plots, another to thinnings in white pine, and a third to a released stand on the land of the New England Box Company.

The second business meeting was held in the evening of September 4 in the auditorium of the Keene Normal School. About sixty were in attendance. Ballot was taken on several names to determine whether the Section should recommend them for senior membership, and a committee was appointed to cooperate with the Appalachian Section in making a unified forest type classification for eastern forests. R. C. Hawley was named chairman. It was decided that the valuation survey of supplies and equipment purchased through foresters should be made through the questionnaire method by the secretary's office with the hope that the material secured would increase Journal advertising.

Mr. A. F. Hawes, Chairman of the Committee on Markets, presented a preliminary report. Reference was made to the price list of New England forest products sent out by the committee, and Mr. Coolidge suggested that the next list be made more specific as to point of delivery. The possible extension of markets for New England forest products was considered in the report, and suggestions were received regarding sources of information which might prove helpful in marketing New England hardwood on the West Coast. The further development of the small dimension business was suggested as a means of extending the market for hardwood, but those familiar with it claimed that the profits were too small to make it attractive. The possible utilization of hardwood for pulp was also proposed by Chairman Hawes, and he described the efforts being made in Connecticut to establish a pulp plant which would consume low grade hardwoods. R. S. Kellog stated that the project would surely meet with failure as there was already an overproduction of pulp. Cooperation of the Market Committee with lumbermen's associations in New England was offered as a means of making the committee's work more effective and useful. Following the discussion, in which Mr. Bristol of the Con-

necticut Lumbermen's Association took part, it was voted to accept the preliminary report.

On the morning of September 5 Professor Toumey conducted a second excursion to parts of the Yale Forest. About seventy took advantage of this opportunity. Various sample plots and field operations were observed including thinnings in white pine, plantations of red and white pine and white spruce, liberation cuttings, effects of grazing, pine marked for reproduction cuttings, and the underplanting of weed hardwoods.

A third meeting was called in the afternoon for the purpose of hearing committee reports. C. E. Behre, Chairman of the Committee on Grazing, pointed out that grazing can be so regulated as to do little harm to softwood reproduction; that in cases where it is desired to get rid of weed hardwoods grazing may be helpful; and that less grazing is being carried on in the back pastures and rocky hillsides, with a strong tendency toward the concentration of grazing on the better soils. In other words, the line between grazing lands and forest lands is being more sharply drawn as time goes on. The summary of observations made in the field together with the conclusions arrived at as a result of the study met with the approval of the meeting, and following the discussion, in which Hawley, Wilson, F. W. Reed, Filley, Crowell, Cromie, Barraclough, Yarnall, and Callward took part, it was voted to accept the report and to submit it to the JOURNAL for publication.

A. C. Cline, New England member of the Society's Industrial Forestry Committee, reported briefly on the work of the Section's Industrial Forestry Committee. The necessary information is being collected through six subcommittees, one for each state. Questionnaire forms have been provided, and it is expected that these will be filled out and returned during the next two months. The American Paper and Pulp Association is cooperating with the Section on the project, and has offered to cover the paper and pulp companies in New England. Other cooperating agencies are the U. S. Forest Service and the National Lumber Manufacturers' Association.

The resolutions adopted expressed the thanks of the Section to Professor James W. Toumey of the Yale Forest and Professor W. E. Mason of the Keene Normal School; congratulated Major R. Y. Stuart on his appointment as Chief Forester of the U. S. Forest Service; recommended the appointment of a Section Committee on Public Education; and urged the establishment of a National Forest in Vermont. The latter resolution read as follows:

> WHEREAS, There are large forest areas in the State of Vermont well adapted to the raising of timber, and whereas the State has suffered from disastrous floods which could to some extent be alleviated by proper forest management, and whereas the State of Vermont has passed an enabling act, We, the New England Section of the Society of American Foresters, hereby urge the National Forest Reservation Commission to establish a National Forest Purchase Area in Vermont.

Luncheon was served both days in the pine grove near the Yale Forest headquarters building. An interesting feature of the meeting was a demonstration by Mr. Ralph Morgan of his new forest fire pump.

A. C. CLINE,
Secretary.

Washington Section Discusses Recreation

The meeting of the Washington Section on October 11, 1928, was devoted to the subject "Recreation in the National Forests." Major Stuart opened the discussion by stressing the importance of recreational values to the citizenry, stating that it was a problem still in its infancy which should be given more thought and study by foresters.

Mr. Seth Gordon, of the Izaak Walton League, stated that the League is emphasizing the importance of outdoor life, and especially the need of additional areas in the Eastern States, which, in contrast of the West, are greatly lacking in National Parks and other forest areas suitable for recreational purposes. One exception, he noted, is that of the Rainey Creek Watershed, an area of 14,500 square miles, a large part of which lies in the Superior National Forest. The Izaak Walton League has put forth much effort to establish an area in this region dedicated to recreational use. The area has been designated the "Quetico Circle," comprising about one million acres in the Superior region on the Canadian boundary. A million acres also lies across on the Canadian side which the League has hopes of inducing the Canadian Government to preserve for a like purpose. The importance and value of the Quetico area for outdoor recreation or playground is at once established by the fact that it is accessible to seventy-five million people. It is the plan to divide this great area into three zones—the outer one for hotels, the second for those people who desire to establish summer camps, and the third to be preserved in its natural state, a wilderness for those who desire to lose themselves for a week, a month, or longer.

This region is the last stand of the moose, and the third zone of the Quetico area would be preserved as a bird and game sanctuary. Under the Izaak Walton League plan roads or trails would not be constructed into the wilderness areas except where absolutely necessary for forest protection.

The proposed reservation of the Quetico area for outdoor life has met with strong opposition from some lumbermen and electric power companies who would remove the timber and flood much of the area. In fact it appears that considerable pressure has been brought to induce the American and Canadian Governments to erect a series of dams in the region under the guise of promoting international navigation. The Izaak Walton League points out that the dams in question would not only serve to promote private business but would spoil this great and valuable recreational area and injure several legitimate industries such as wood using industries and the tourist trade.

A congressional investigation committee visited the Quetico area this past summer and is reported as being much impressed with its value as a national outdoor playground.

Mr. Gordon explained the provisions and purposes of the Shipstead-Newton Bill introduced (1) to preserve and safeguard the timber along the lake shore in the Quetico region; (2) to withdraw from occupancy 20,000 acres of the public domain; (3) to prevent the Federal Power Commission or any Government bureau from issuing a permit to flood the area prior to full investigation by Congress.

Mr. Barrington Moore, a member of the Coordinating Committee on National Parks and National Forests, discussed the problems that arise in adjusting the boundaries of National Parks and National Forests. In doing this it appears that the Commission is guided by the recreational use as against economic use of the areas in question. He noted examples of areas mostly suitable for recreation that have been added to National Parks, citing the Yellowstone as one. He also stated that the object sought by Swiss authorities in park administration appears to be that of preserving forest areas in their natural condition.

Mr. Paul Redington, Chief of the Biological Survey, next spoke of the areas suitable for outdoor recreation in the Mississippi Wild Life Preserve, and of the use of hydroplanes in visiting the inaccessible areas in Alaska. It appears that citizens of Alaska now frown on the use of air transportation, which is destroying the business of the guides and tourist trade in general. Instead of spending months in Alaska the aviator tourist spends but a few days and flies away. Mr. Redington stressed the need of preserving inaccessible forest areas in their natural state which could not be spoiled by flier tourists.

Mr. Philip Ayres, Forester for the Society for the Protection of New Hampshire Forests, spoke of the recreational problems in the White Mountains of New Hampshire. He stressed the growth and continuation of wood-using industries of that region, the wild life, and game refuges. He stated that the conclusion had about been reached that cottage permits would not be issued in the future for occupancy in the White Mountain forest areas.

Mr. O. M. Butler, editor of "American Forests and Forest Life," spoke of the growing problem of outdoor recreation, and the need of preserving forest areas in the natural state for present and future generations. He stated that the Quetico area previously described by Mr. Gordon was highly suited to outdoor life, and that the use of hydroplanes would permit thousands of people from the cities to visit in a few hours that land of the lakes.

Major G. P. Ahern, Chairman of the Section, in closing the evening's meeting recalled experiences he had had in Montana in 1888. Outdoor life in what is now the Glacier National Park was described. It appeared that fish bit so well in those days that he caught trout while fording the Flathead River horseback. "Them days are gone forever."

E. Morgan Pryse,
Secretary-Treasurer.

Ohio Valley Section Explores Southwestern Michigan

Twenty-one foresters of the Ohio Valley Section started their annual meeting on the evening of October 20 with a dinner at the Dyckman House at Paw Paw, Michigan. This community is near the center of an interesting region of old windbreak and grove plantations, fine but small tracts of native hardwoods, recent coniferous plantings, and plenty of sand dunes which are yielding in their restlessness under forestry efforts.

Chairman John C. DeCamp announced that no special program was arranged for the evening but called on various members for brief accounts of developments in their fields.

Burr N. Prentice told of new utilization studies initiated in Indiana and of State Forester Wilcox's plan for strengthening the state fire organization. B. E. Leete, of Ohio, told something of the protection program in his state, emphasizing the lookout tower work. Shirley Allen spoke of the Society's industrial forestry inquiry and of the need for new material in the way of news and Society doings for the JOURNAL. O. A. Alderman reported on the plan for a uniform type classification for the forests within the territory of the Ohio Valley Section, and in the discussion which followed it was decided to table the undertaking pending report from the Central States Forest Experiment Station along the same line. Alvin G. Whitney told of the aims of the University of Michigan in forest zoology teaching and research work.

Report by A. K. Chittenden on a study made as a part of the Clarke-McNary tax inquiry precipitated the main discussion of the evening. It was brought out that the Pearson Law in Michigan, which is the usual yield tax law with the abnormally high yield tax of twenty-five per cent and a land tax which can be changed and become retroactive at any session of the legislature, was not working well. H. J. Andrews, of the Department of Conservation, reported that yield taxes had already been collected on land classified for less than three years and felt that it would be difficult to induce the people of Michigan to vote for a constitutional amendment which would allow the land tax to remain constant. The amendment of the act will probably come up in the next session of the legislature.

Interesting discussion of Michigan's fire protection organization disclosed numerous developments in equipment and method. These included the use of small tractors, which can be hauled on a truck, for plowing line to control a fire; deep plowing to control muck fires; and the sinking of well points to get water for pumps on a fire. After reporting on these, Mr. Andrews spoke of action by some of the railroads in fifty-fifty financing of fire-line construction and of the increasing number of visitors to lookout towers and the opportunity of towermen of the right sort to help in public relations work. In some cases he felt that this might even interfere with the towerman's regular duties, but that capitalizing on tower visits was a matter for real study.

Friday, October 18, included a visit to Hathaway Woods, a 20-acre planting of a large number of both coniferous and hardwood trees made sixty-three years ago when Michigan was full of virgin timber. In spite of wide spacing (rows one rod apart and trees about six feet apart in row) the trees in many cases are clean and show splendid growth as might be expected on good prairie soil. A small grove of American chestnut which is free from blight and some excellent white pine and Norway spruce were particularly interesting.

Newton woods near Volonia, a splendid stand of original hardwoods, exhibited some large specimens of elm, maple, and yellow poplar and gave some of the members their first introduction to the paw paw as an edible fruit. Some of them do not now retain this conception.

A 16-acre plantation of white pine, 16 years old, showed unusual growth on the

Grant Farm near Lawrence. The soil was sandy but apparently contained more organic matter than usual to native white pine stands.

After a two o'clock fish dinner at South Haven, the group visited the Simmonds estate of 100 acres on the shore of Lake Michigan not far from Ganges. Here the owner has been working to control blow sands and has had fair success with white pine, red pine, Norway spruce, and various poplars. Scattered brush from dead native species has helped to hold the sand. A small nursery is maintained.

The second evening was to have been spent about a campfire on the lake shore near Saugatuck but rain prevented this and the business session was held at the Butler Hotel in Saugatuck. A number of membership recommendations were agreed upon, C. J. Telford, of Illinois, was elected Chairman for the ensuing year, and S. S. Locke, of Illinois, was appointed to organize the survey of supplies and equipment purchased through foresters, to increase JOURNAL advertising. The following resolution was adopted on the passing of J. Girvin Peters:

> We have heard with deep sorrow of the passing of J. Girvin Peters, a tireless worker for the Society of American Foresters, a forester of unusual achievement, and a true friend, and in expressing our own feeling of deep personal loss and loss to the profession, we want to extend our sincere sympathy to his family.

Saturday forenoon, October 20, was spent in going over the Felt estate of 800 acres where Goshorn Lake is gradually filling with sand blown over from the Lake Michigan dunes. Faith in the possibility of controlling blow sand here has led the owner to build a magnificent home, establish an extensive nursery for both coniferous and hardwood stock, and plant the blow sands at points where the sand is being blown out. Belts of native hardwoods and encouraging growth of planted white pine point to the history of the tract as original mixed forest.

The entire trip was a great success in point of interesting field sessions and good fellowship.

SHIRLEY W. ALLEN.

STANDARDIZED FORM FOR PAPERS AND LITERATURE CITATIONS

With all due respect for the high quality of the contributions which have appeared in the JOURNAL OF FORESTRY in the past, the writer would like to raise the question whether it might not be appropriate to consider the standardization of certain forms for the presentation of articles in the JOURNAL. There are two main divisions to such a question:

a. The form, or outline, of the paper.

b. The manner in which literature citations are made.

Both these subjects are standardized in such publications as Botanical Gazette, Journal of Agricultural Research, Monthly Weather Review, Ecology, and Soil Science, to name only a few to which foresters are in the habit of contributing. These are all journals of high scientific standing and well edited, so it would seem that there must be some distinct advantage to be gained by such standardization. Unfortunately all these journals do not follow the *same* form, but require the *same form for all papers within their own pages.*

It may be contended that the enforcement of a rigid outline or form for all papers submitted would curtail freedom of style, and make articles dry and un-

interesting. The writer does not believe in this viewpoint, since he believes that the use of a short summary following the body of the paper, together with proper headings for subdivisions aids the reader and makes papers more readable. Surely it tends toward clarity of thought both in author and reader, and compels the former to arrange his ideas systematically when writing. Obviously, no one method or arrangement will be suited to all articles, but certainly it would not be too much to ask that all papers be followed by a summary, or possibly a numbered list of the conclusions reached.

In the matter of literature citations, no hardship to authors would be caused by insisting upon a uniform form for citations, be they footnotes, or a bibliography at the end of the paper. Unfortunately there is still no uniformity in this practice, although there appears to be no reason why an internationally recognized form for citations could not be adopted. Until one is, the system used by Biological Abstracts or Chemical Abstracts, as brief as is consistent with completeness, may serve as a model. During the past few years considerable discussion of this question has taken place in Science, showing that there is considerable lack of agreement among scientific men as to the one best form for citations.

The Editorial Board could well give this matter careful study. Such handbooks as Trelease and Yule's "Preparation of Scientific and Technical Papers," and similar works, contain many examples of different forms of citations. Perhaps one of the greatest benefits of uniformity in making citations in the JOURNAL OF FORESTRY would be that authors would be led to give the authority for their statements accurately and completely, so that a reader could look up their references. This would greatly increase the value of a paper as material for reference, and the JOURNAL as a reference publication.

HENRY I. BALDWIN.

REPRINTS FOR AUTHORS

Hereafter the Society will pay half the cost of any number of reprints up to 100 which authors may desire to order. This applies only to articles as they originally appeared in the JOURNAL, and not to reviews, notes, or society affairs items. Any additional costs due to covers, renumbering of pages, or other changes must be met by the author. Special notices will be sent to all authors, giving them an opportunity to order reprints, but all orders must be submitted promptly while the magazine is still on the press, since otherwise resetting will be necessary at greatly increased cost.

S. T. DANA.

SOCIETY CORRESPONDENCE

As a result of personal experience it has been suggested by an ex-secretary of one of the sections that Society correspondence with either national or section officers should be so addressed as to indicate clearly that it has to do with Society affairs and is not a purely personal communication. In the absence of the individual addressed this will avoid delay by making it possible for the correspondence to be opened and handled by a deputy. In cases where the officer in question is on a long field trip or has moved to another part of the country this may readily save a week or two in the handling of Society business.

Announcement of Candidates for Membership

The following names of candidates for membership are referred to Members, Senior Members, and Fellows for comment or protest. The list includes all nominations received since the publication of the list in the October Journal, without question as to eligibility; the names have not been passed upon by the Executive Council. Important information regarding the qualifications of any candidate, which will enable the Council to take final action with a knowledge of essential facts, should be submitted to the undersigned before January 15, 1929. Statements on different men should be submitted on different sheets. *Communications relating to candidates are considered by the Council as strictly confidential.*

FOR ELECTION TO GRADE OF MEMBER

Name and Education	*Title and Address*	*Proposed by*
Beiter, H. L. Penn. State, B. S. F., 1916	Tie and Timber Agent, Lehigh and New England Railroad, Pen Argyl, Pa.	Allegheny Sec.
Belcher, Robert Gregory Dartmouth, B. S., 1924; Yale Forest School, M. F., 1926	Forest Engineering Department, International Paper Company, Fredericton, N. B.	J. W. Toumey R. C. Bryant R. C. Hawley H. H. Chapman
Bishop, George Norman Univ. of Ga., B. S. F., 1926	Experimental work, Hercules Powder Co., Hattiesburg, Miss.	Gulf States Sec.
Brown, Raiford F. Univ. of Ga., B. S. F., 1926	Forester, Hercules Powder Co., Hattiesburg, Miss.	Southeastern Sec.
Franklin, F. F. Purdue Univ., B. S., 1922; N. Y. State Col. For., M. S., 1924	Instructor of Forestry, Purdue Univ., Lafayette, Ind.	Ohio Valley Sec.
Godden, Floyd W. Univ. of Idaho, B. S. F., 1927	Junior Forester, Payette Nat. Forest, Emmett, Ida.	Intermountain Sec.
Goodman, B. A. Winter courses in forestry since 1920-21. 16 years' practical experience	Senior Ranger, Canton, Mont.	No. Rocky Mt. Sec.
Hanley, John H. Univ. of Mich., B. S. F., 1927	Junior Forester, Ohio Valley Forest Experiment Station, Youngstown, Ohio.	Ohio Valley Sec.
Hoffman, Henry C. Univ. of Idaho, B. S. F. & M. S., 1928	Forest Ranger, Wyoming Nat. Forest, Daniel, Wyo.	Intermountain Sec.
Holdsworth, Robert Powell Mich. State Col., B. S F., 1911	Student, Yale Forest School.	New England Sec.
Kaylor, Joseph F. Penn. State, B. S. F., 1927	Forester in charge of State Nurseries, Indianapolis, Ind.	Ohio Valley Sec.
Klehm, Karl A. Univ. of Montana, 2 years' short course	Chief Lumberman, Kootenai Nat. Forest, Libby, Mont.	No. Rocky Mt. Sec.
Liddell, Earl R. N. Y. State Ranger School, 1923	Manager, Winchendon Forest Tree Nurseries, Inc., Winchendon, Mass.	New England Sec.

Name and Education	*Title and Address*	*Proposed by*
Malsberger, Henry J. Penn. State, B. S. Industrial Engineering in Lumbering, 1925	Forest Assistant, Florida Forest Service, Tallahassee, Fla.	Southeastern Sec.
May, Richard M. Penn. State, B. S. F., 1927	Forest Inspector, Penn. Dept. Forests and Waters, Nanticoke, Pa.	Allegheny Sec.
Munster, Norman L. Univ. of Mich., B. S. F., 1926	Forest Technician, Univ. of Mich., Ann Arbor, Mich.	Ohio Valley Sec.
Neubrech, W. LeRoy N. Y. State Col. For., B. S., 1927, M. F., 1928	Assistant in Forestry Department, Purdue Univ., Lafayette, Ind.	Ohio Valley Sec.
Nothstein, Wm. L. Penn. State, B. S. F., 1927	Field Assistant, Appalachian Forest Experiment Station, Asheville, N. C.	Appalachian Sec.
Nuite, Charles Wayne Univ. of Ga., B. S. F., 1927	District Forester, Georgia Forest Service, Waycross, Ga.	Southeastern Sec.
Olson, Charles Three months' ranger course, Univ. of Montana; 5 years' practical experience and 18 years' experience in woods work	Forest Ranger, Ovando, Mont.	No. Rocky Mt. Sec.
Paine, Philip Oregon State, B. S., 1928	Forest Ranger, Beaverhead National Forest, Wisdom, Mont.	No. Rocky Mt. Sec.
Rathbun, Lawrence W. Harvard Univ., B. A., 1922; Corpus Christi College, Cambridge, England, 1923; Yale, M. F., 1927.	Forester, Dublin Associates, Dublin, N. H.	New England Sec.
Robbins, Putnam W. Mich. State Col., B. S. F., 1927	Research Assistant, Dunbar Forest Experiment Station, Sault Ste. Marie, Mich.	Ohio Valley Sec.
Roche, A. J. Ranger course, Univ. of Montana, 1915; 18 years' practical experience	Assistant Forest Supervisor, Cœur d'Alene, Ida.	No. Rocky Mt. Sec.
Saling, Wallace Marion Univ. of Idaho, B. S. F., 1928	Field Assistant, No. Rocky Mountain Experiment Station, Priest River, Ida.	No. Rocky Mt. Sec.
Sanderson, Stanley C. Ranger course, Univ. of Mont., 1916; 14 years' practical experience	Assistant Forest Supervisor, Cœur d'Alene, Ida.	No. Rocky Mt. Sec.
Scribner, Henry A. Univ. of Maine, B. S. F., 1928	Division Forest Fire Warden, New Jersey Forest Service, Trenton, N. J.	Allegheny Sec.
Shaner, Fred W. Two years Univ. of Idaho	Forest Ranger, Selway Nat. Forest, Kooskia, Ida.	No. Rocky Mt. Sec.
Stouffer, David J. Mich. State Col., B. S. F., 1926	Blister Rust Control Agent for Mich., East Lansing, Mich.	Ohio Valley Sec.

Name and Education	*Title and Address*	*Proposed by*
Spence, Liter E. Univ. of Idaho, B. S. F., 1928	Forest Ranger, Cache National Forest, Logan, Utah.	Intermountain Sec.
Stranz, Martin Univ. of Mich. and Univ. of Wash.	Forest Ranger, U. S. F. S., Vernal, Utah.	Intermountain Sec.
Tinker, John Minton Univ. of Ga., B. S. F., 1924	Timber Cruiser, Jacksonville, Fla.	Southeastern Sec.
Tonkin, Robert D. Common schools; Mt. Union College, Alliance, Ohio; 35 years' practical experience in forestry	Supt., Timber Dept., H. C. Frick Coke Co., Leckrone, Pa.	Allegheny Sec.
Tusler, Henry S. Short course in For., Univ. of Wash., 1921	Assistant Land Agent, Potlatch Lumber Company, Potlatch, Ida.	No. Rocky Mt. Sec.
White, Eric P. High school and study courses; 7 years' practical experience	Senior Ranger, Eldridge, Mont.	No. Rocky Mt. Sec.
Wissen, George G. Cornell Univ., B. S. F., 1928	Secretary, Mahogany Association, Inc., Corono, L. I., New York.	New York Sec.
Wood, Lamar M. Mich. State Col., B. S. F., 1925; graduate work, 1928	Graduate Assistant, Forestry Dept., Mich. State College, Caro, Mich.	Ohio Valley Sec.
York, O. E. Three years' college, Math. & Elec. Engineering; 11 years' practical experience	Senior Forest Ranger, Stacey, Mont.	No. Rocky Mt. Sec.

FOR ELECTION TO GRADE OF SENIOR MEMBER (FROM MEMBER)

Fletcher, Elmer D. Common schools only; 40 years' practical experience (Member 1921)	Consulting Forester, Winchester, Mass.	New England Sec.
Garratt, George A. Mich. Ag. Col., B. S. F., 1920; Yale, M. F., 1923 (Member 1924)	Assistant Professor of Forest Products, Yale School of Forestry, New Haven, Conn.	New England Sec.
Lockard, Charles R. N. Y. State Col. For., B. S. F., 1923; Harvard Univ., M. F., 1924 (Member 1925)	Forester, Diamond Match Co., Biddeford, Maine.	New England Sec.
Reynolds, Harris A. West Virginia University, B. S. C. E., 1909; Harvard Univ., M. L. A., 1911 (Member 1923)	Secretary, Massachusetts Forestry Association, Boston, Mass.	New England Sec.

Name and Education	*Title and Address*	*Proposed by*
Spaulding, Perley Univ. of Vermont, B. S., 1900; Washington Univ., M. S., and Ph. D., 1906 (Member 1926)	Pathologist, Bureau of Plant Industry, Amherst, Mass.	New England Sec.
Whitney, Raymond L. Two years special forestry, Univ. of Maine, 1914; six weeks Yale Forest School (Member 1923)	Private forestry business, Bingham, Maine.	New England Sec.

FOR ELECTION TO GRADE OF SENIOR MEMBER

Benedict, R. E. Specializing in horticulture and forestry, Univ. of Nebraska, 1900; M. F., 1919 (Honorary)	Manager of 100,000 acres cut over land in southeast Ga.	Southeastern Sec.
Matthews, Donald Maxwell Univ. of Mich., A. B., 1908, M. S. F., 1909	Professor of Forest Management, School of Forestry and Conservation, Univ. of Mich., Ann Arbor, Mich.	Ohio Valley Sec.

B. A. Chandler,
Member of Executive Council in Charge of Admissions.

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Secretary, Ward Shepard, Forest Service, Washington, D. C.
Treasurer, B. A. Chandler, Bureau of Internal Revenue, Washington, D. C.

Executive Council

The Executive Council consists of the above officers, the Editor-in-Chief of the Journal of Forestry, and the following members.

	Term expires
R. Y. Stuart	Dec. 31, 1932
Aldo Leopold	Dec. 31, 1931
T. T. Munger	Dec. 31, 1930
B. A. Chandler	Dec. 31, 1928
Member in charge of admissions	
E. H. Frothingham	Dec. 31, 1928

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H. F. Round, Secretary, Forester's Office, Pa. R. R. Co., Philadelphia, Pa.

Appalachian

C. F. Korstian, Chairman, Appalachian Forest Experiment Station, Asheville, N. C.
M. A. Mattoon, Vice-Chairman, U. S. Forest Service, Asheville, N. C.
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E. J. Hanzlik, Secretary, Box 4137, Portland, Ore.

Ohio Valley

J. C. DeCamp, Chairman, Michigan State College, East Lansing, Mich.
E. V. Jotter, Secretary, University of Michigan, Ann Arbor, Mich.
B. E. Leete, Chairman of Membership Committee, Room 51, First National Bank Bldg., Portsmouth, Ohio.

Southeastern

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R. P. A. Johnson, Secretary, Forest Products Laboratory, Madison, Wis.

ANNUAL MEETING, DECEMBER 28-29

Don't forget the Annual Meeting in New York City, December 28-29, and make an effort to attend. An interesting and worth-while program has been prepared and we expect the largest attendance in our history. The Headquarters of the Society of American Foresters will be the Paramount Hotel, 235 West 46th Street and comparatively low rates have been obtained for Society members. Make your room reservations direct to the Hotel. Bulletin and folder, telling of the Annual Meeting arrangements, may be had from your Section Secretary

REMEMBER THE DATES

WE WILL PAY

50 cents for each copy of the following which you send us. They are badly needed for our files.

Proceedings
Volume 9—No. 3

Forestry Quarterly
Volume 1—No. 3
Volume 1—No. 4

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